DOCUMENT RESUME

ED 187 562 SE 030 964

TITLE	A National Assessment of Achievement and Participation of Women in Mathematics. Final Report.
INSTITUTION	Education Commission of the States, Denver, Colo. National Assessment of Educational Progress.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
REPORT NO	NAEP-10-MA-60
PUB DATE	Dec 79
GRANT	NIE-G-77-0061
NOTE	288p.
EDRS PRICE	MF01/PC12 Plus Postage.
DESCRIPTORS	*Academic Achievement; Career Choice; Educational Assessment; Elective Courses; Females; *Mathematics Education; *National Surveys; Parent Influence; Participation; *Research; Secondary Education; *Secondary School Mathematics; *Sex Differences; Sex Role; Sex Stereotypes; Student Attitudes; Surveys; Teacher Influence

ABSTRACT

The purpose of this study was to identify the most important factors related to the problem of women's participation in mathematics and to determine the relative importance of those factors to guide future research and intervention efforts. The vehicle was a national survey of 1,452 13-year-olds and 1,788 high school seniors. Data collection centered upon achievement and participation in mathematics, sex-role stereotyping, career and academic plans, the students' attitudes toward mathematics, parental influence, and the influence of significant other people in the students' lives. Results of the study indicate that 13-year-old females begin their high school mathematics career with at least the same ability as their male contemporaries. By the twelfth grade, males have overtaken females. Large sex differences found for mathematics participation in previous studies were not found in this survey. Results also indicate that certain groups of variables open to intervention strategies are related to participation. Three groups of variables were found to have the greatest effect on participation: positive attitudes toward mathematics; perceived need for mathematics for future career and educational plans; and influences of significant others, including parents, teachers and counselors. At the report conclusion, strategies are suggested which may increase mathematics participation in school programs. (Author/MK)

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FINAL REPORT TO THE NATIONAL INSTITUTE OF EDUCATION

A NATIONAL ASSESSMENT OF ACHIEVEMENT AND PARTICIPATION OF WOMEN IN MATHEMATICS

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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GRANT NO. NIE-G-77-0061
DECEMBER, 1979

A NATIONAL ASSESSMENT OF ACHIEVEMENT AND PARTICIPATION OF WOMEN IN MATHEMATICS

Final Report to the National Institute of Education on
its Two-Year Grant to the Education Commission of the States

October 1, 1977 through November 30, 1979
Grant No.: NIE-G-77-0061

Report No.: 10-MA-60

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JUN 1 3 1980

The information contained in this report is based on a project supported by the National Institute of Education under Grant No. NIE-G-77-0061. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the author and do not necessarily reflect the views of the National Institute of Education.

ISBN 0-89398-144-3

ABSTRACT

The purpose of this study was to identify the most important factors related to the problem of women's participation in mathematics and to determine the relative importance of those factors to guide future research and intervention efforts. The vehicle for the study was a national survey of 1,452 13-year-olds and 1,788 high school seniors. The data collection centered upon achievement in mathematics, participation in mathematics, sex-role stereotyping, career and academic plans, the students' attitudes toward mathematics, parental influence, and the influence of significant other people in the students' lives. Correlation and regression analyses were performed on the survey data to identify those factors which most affect participation and achievement in mathematics.

The results of the study indicate that 13-year-old females begin their high school mathematics career with at least the same ability as their male contemporaries. In fact, 13-year-old girls are better at computation and spatial visualization than males. Their problem-solving skills are nearly equal.

By the twelfth grade, males have overtaken females. Males excel in problem-solving but have abilities in spatial visualization and computation comparable to those of their female counterparts. The hypothesis that males dominate mathematics because they have a superior ability in spatial visualization is not supported by the study results. For twelfth graders, no sex differences were found for spatial visualization.

The large sex differences found for mathematics participation in previous studies were not found in this national survey. It was also found that most of the factors which seem to affect participation for the older group are the same for males as well as females.

The results also indicate that certain groups of variables open to intervention strategies are related to participation and

that these variables predict participation. Three groups of variables were found to have the greatest effect on participation:

- positive attitudes toward mathematics
- perceived need for mathematics for future career and educational plans
- influences of significant others, including parents, teachers and counselors

The results implied intervention strategies aimed at instilling and sustaining the positive influences of these factors are good prospects for maximizing participation in mathematics.

At the conclusion of this report, strategies are suggested which may increase mathematics participation in school programs. All of these strategies could have significant influence in assuring that mathematics attracts both males and females.

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ACKNOWLEDGMENTS

Many individuals, both on staff and from various universities and organizations have made substantial contributions to this project. Not the least of those to be gratefully acknowledged are the administrators, teachers and students who cooperated during the collection of the survey data.

Special acknowledgment must go to Drs. Judy Shoemaker and Kent Sullivan of the National Institute of Education for their cooperative efforts as project officers.

Also to be acknowledged are the substantial contributions in guiding the development and analysis of the survey instruments made by members of the Women in Mathematics Advisory Board: Dr. Lorelei Brush, Dr. Lynn Fox, Dr. Shirley Hill, Dr. Jeremy Kilpatrick and Dr. James W. Wilson.

Administration of the survey was conducted by the Research Triangle Institute, Raleigh, North Carolina. Scoring and processing were carried out by Westinghouse DataScore Systems, Iowa City, Iowa, and by the National Assessment staff.

Numerous members of the National Assessment staff contributed their expertise to various aspects of this study. Special thanks must go to the following people: Nancy Burton for her assistance in conceptualizing the study; Stuart Kahl for his work on the development of the survey; Dunlap Scott for the coordination of the administration with the Research Triangle Institute; Susan Sullivan for the coordination of the scoring with DataScore Systems; Donald Searls, Gene Johnson and Alex Pearson for assistance in statistical techniques; John Kalk, Ingrid Larsson and Arlen Price for computer program development and data processing support; Mary Jane Gosslee and Carmen Nietes for the production of this report; and Roy Forbes for his continuous support for the duration of this project.

CHAPTER I

INTRODUCTION

Among U.S. women who pursue a career outside the home, very few choose roles in science, engineering or medicine.

Social, educational and cultural barriers have prevented women from entering such technical fields. These barriers have existed for years, and despite hopeful rhetoric, they have changed little during the last half century. Only one-tenth of one percent of engineers are women; only two percent of physicists are women; only five percent of chemists are women.

Many factors work against women's entry into technical fields. For example, most technical pursuits require training in college-level mathematics. Without such training, women are barred. However, women's mathematics course-taking deficiency begins long before college and, by the time most women reach college, they do not have the mathematics background necessary for technical careers. According to a 1978 report from the College Entrance Examination Board, approximately 63 percent of college-bound males had taken four or more years of high school mathematics. Only 43 percent of females were similarly qualified. In most colleges and universities, four years of high school mathematics are required to take calculus--which is in turn required for virtually every technical or scientific major. Thus, without remedial work, more than half of all college-bound women are unable to major in the technical fields.

Why do women often avoid careers that require a foundation of mathematics? It is generally accepted that elementary school girls excel in arithmetic and science. However, the picture begins to change in junior high school as boys overtake and pass their female contemporaries in mathematics achievement. From the eighth grade on, female participation in mathematics declines steadily until, by high school graduation, male students outnumber women in mathematics classes.

Most of the large-scale research studies conducted in the last twenty years on sex differences in mathematics achievement and participation focused on these facts to support an underlying premise that since males traditionally take more mathematics they, therefore, tend to have higher achievement scores.

Traditional attempts to explain women's lack of participation in mathematics have viewed mathematics, a discipline characterized by abstract logic and deductive thought, as basically unfeminine. Through the ages mathematics has been regarded as a male domain. Women supposedly shy away from the logic and deductive thought required by mathematics in favor of aesthetic beauty and intuitive thought.

In fact, in earlier ages it was believed that women could not pursue mathematics because, for example, their heads were too small, their nervous systems too delicate or their reasoning capacities insufficient. Such an eminent educational theorist as Rousseau believed that women were not qualified for research in abstract areas such as mathematics and science because their brains were unfit.

While such notions are clearly passé, they do have 20th century counterparts. For example, the possibility of a genetic effect favoring males in the area of spatial visualization is currently a topic under investigation. Is there a genetic barrier against female participation in mathematics? Or do society's preconceptions condition women against excelling in mathematics?

Preconceptions can be manifested in many factors in a young woman's environment. The interaction of these factors may work to help or hinder her in mathematical progress. Identifying and examining these factors and their interaction was one of the objectives that the National Institute of Education addressed with the Women and Mathematics grant program. Specifically, the program was designed to "identify and explain how selected cognitive, affective, educational, familial or social factors influence achievement and participation of women . . . in their study of mathematics, their attitudes toward the study and usefulness of mathematics and their preferences for occupations requiring mathematical competence."

This study was conducted by the Education Commission of the States (ECS) as a part of the Women and Mathematics program to identify the most important factors related to the problem of women's participation in mathematics and, further, to explore the relative importance of those factors in an effort to guide future research and to aid the development of strategies to remove the bias against women in the world of mathematics.

The survey approach is particularly appropriate for a complex problem such as somen's participation and achievement in mathematics where the diversity of factors and their relationships may offer numerous plausible explanations. Previous studies reflect a clear lack of agreement regarding the effect of many of the variables on participation. Most of these studies looked at only a few of the possible affective factors at one time. Further, the sample sizes were small and the results frequently inconclusive due to a lack of statistical power. A national sample such as that used in the current study is one way to resolve the conflicts produced by previous limited samples. A large-scale survey can detect the small but stable influences overlooked by smaller, less sensitive studies. Thus, a major significance of the study reported here will be the determination of the relative importance of each of the possible factors affecting women's participation in mathematics.

CHAPTER II

RELATED RESEARCH

Introduction

Brief reviews of previous research findings on variables affecting women's participation and achievement in mathematics are presented in this chapter. These reviews rely heavily on previous work done by Fox, Fennema and Sherman for the National Institute of Education in a collection of papers entitled Women in Mathematics: Research Perspectives for Change (1977). Brief summaries of research findings are presented for variables chosen for this study.

Mathematics Achievement

Several large-scale national surveys have found sex differences in mathematics achievement, with males outperforming females at the older ages. The two mathematics assessments completed by the National Assessment of Educational Progress found sex differences in achievement beginning at the junior high school level and continuing through high school and early adulthood. In the first assessment of mathematics by the NAEP (1972-73) there were no significant achievement differences between the sexes for 13-year-olds, but at age 17, males averaged almost five percentage points higher than females across all items. Young adult males (ages 25-36) outperformed females by ten percentage points. In the second NAEP mathematics assessment (1977-78) achievement patterns for the sexes were similar to the results of the first assessment. Again, there were not significant differences in achievement between 13-year-old males and females, but at age 17, males performed three percentage points higher than females with the largest sex-related differences being at the higher cognitive levels of understanding concepts and principles (3.6% advantage for males) and application (5% advantage). In the first assessment, no information was collected on mathematics course background, so differences in achievement could have been explained in terms of differential course taking.

In the 1962-67 National Longitudinal Study of Mathematical Ability (NLSMA) Wilson (1972) reported "differences favoring girls were for variables at the application and analysis level. Course background was controlled and achievement differences between the sexes were significant."

In a smaller study, Fennema and Sherman (1976) investigated mathematics achievement in grades 6 through 12 in selected Wisconsin schools during the 1975-76 school year. In grades 9 through 12, with subjects whose mathematics backgrounds were carefully controlled, they found significant differences in achievement in favor of males in two of four schools tested. In another of the four schools, significant differences were found in favor of males for a high level mathematical cognitive task.

Schonberger (1976) thoroughly reviewed many problem-solving studies which used sex as a variable. Although male-female differences were small, she found males did appear to perform better than females during early adolescence and that this difference increased with their maturation.

Hilton and Berglund (1974) used longitudinal data to identify attitudinal factors as possible causes of differences in achievement between the sexes. Data were collected from a nationwide sample of fifth graders in 1961, and again when they were in the seventh, ninth and eleventh grades. The STEP and SCAT tests were used. They found that at grade five there were no differences in achievement. However, at the later grades boys did surpass girls, with parallel attitude differences emerging with respect to perceiving mathematics as interesting and likely to be helpful in earning a living.

In summary, most of the large-scale studies performed during the sixties and seventies have found significant sex differences in achievement beginning at about puberty and continuing through adulthood with males generally having superior scores. Males have tended to perform better on tasks considered to tap the higher cognitive levels in mathematics course taking, i.e., since males have traditionally taken more mathematics, they tend to achieve higher scores.

Mathematics Participation

Mathematics course taking or participation was not controlled in many of the reported studies which looked at sex differences in achievement. However, several recent studies have attempted to determine the extent of sex-related differences in participation and its effect on achievement. Sells (1973) found incredible differences in course taking between the sexes. She noted:

1. In a systematic random sample of freshmen admitted at Berkeley in the fall of 1972, 57 percent of the boys had taken four full years of mathematics, including the trigonometry-solid geometry sequence, compared with 8 percent of the girls.
2. Among students earning the Bachelor's degree in the 21 largest letters and science departments, there is a strong and statistically significant relationship between having a one-year college mathematics requirement in the curriculum, and having less than one-third of the degrees in the department earned by women.[1]

Ernest (1976) repeated Sells experiment on a random sample of University of California at Santa Barbara students in the fall of 1973. "The percentage of entering men with four years of high school mathematics was considerably smaller (36 percent) while the percentage of entering women was somewhat larger (16 percent). Nevertheless, the sex difference is still enormous (and statistically significant) and thus confirms Lucy Sells' findings at Berkeley."[2]

Fennema and Sherman (1976) analyzed Wisconsin statewide enrollment data for each sex for 1975-76. They noted that differences in enrollment patterns began to appear at Algebra II when about 14 percent more men took second year Algebra. Differences in participation between the sexes increased with the higher level mathematics courses. Three men for every two women took Pre-Calculus or Trigonometry, twice as many men took Analytic Geometry, and three times as many took Calculus. More recent data from the second NAEP mathematics assessment (1978) also indicated differential enrollment in the higher level mathematics courses in high school.

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[1] Lucy Sells, "Sex and Discipline Differences in Doctoral Attrition," (Ph.D. Dissertation, University of California, Berkeley, 1975).

[2] John Ernest, Mathematics and Sex (University of California at Santa Barbara, 1976), p.652.

No differences in participation were found through Algebra II, but significantly more men took Trigonometry (20.5% for males and 16.9% for females) and Pre-Calculus or Calculus (6.1% versus 4.4%).

Sex Role Stereotyping and Career Plans

Numerous studies have attempted to determine the relationship of sex-role stereotyping and career pursuits of women. Research on the marital and familial status of working women has centered on three issues: 1) the happiness of husband and wife if the wife works, 2) the impact of a working wife on the children, and 3) the identification of how tasks and roles in the home are defined when the woman works.

Studies suggest that many females regard careers for themselves as incompatible with family responsibilities. Commitment of a woman to a professional career would interfere with homemaking, raising a family, the husband's success and the happiness of a marriage. Rossi (1965b) suggested that men believe (and women accept the belief) a woman's primary role is as man's helpmate and a career should occupy only spare time. Obviously, this role is not compatible with a woman's professional career. Astin (1974b) concluded that if a woman anticipates a conflict between the traditional female role of homemaking and a career, she is much more likely to choose the traditional role. Ory and Helfrich (1976) investigated the interaction of individual characteristics and career selection of college men and women. They found that women desiring professional careers were less traditionally oriented in their views of women's sex role identity than were women choosing non-professional careers.

Smith (1976) interviewed high ability students about career plans just after they entered college. Women who perceived barriers to scientific careers reported feeling a conflict of roles rather than any perceived lack of ability. They believed a science-oriented career would interfere with raising a family, might not complement their husband's career and would interfere with their marriage.

Hawley (1971, 1972) and Astin (1974b) concluded that marriage was the primary goal of most women, and if they did elect a career, it was based on what they felt men could tolerate. Astin (1974b) found that while husbands of career women may be tolerant or even supportive of their wives, professional men tended to hold negative attitudes towards women who tried to fulfill the dual role of career woman and homemaker.

Astin (1976b) concluded that there was little empirical evidence on how differences come to exist between women who decide to work and those who do not. One notable exception is the finding that girls who persist in career interests from high school to adulthood are likely to score higher on mathematical aptitude tests than less career-oriented girls (Astin, 1968; Astin, 1974a; Astin and Myint, 1971).

Mathematics as a Male Domain

The sex-typing of mathematics as a "male domain" was the focus of several studies. Researchers have noted the potential conflict for girls between academic achievement and popularity (Coleman, 1961; Hawley 1971, 1972; Komarovsky, 1946; Lavach and Lanier, 1975). Success in a domain labeled "feminine" was less threatening for females than success in a domain labeled "masculine." Results of these studies indicated that as long as mathematics is considered to be a masculine domain, achievement conflicts are likely to exist for girls.

Fennema and Sherman (1976) found that girls reported not pursuing advanced mathematics courses because taking such courses might hamper their social relationships with boys--even though they responded that men had no effect on their course-taking behaviors on a paper and pencil measure of mathematics as a male domain.

Another plausible explanation of mathematics stereotyping which has been the focus of other research studies is the masculine identification hypothesis. Briefly stated, boys and girls who identify with their fathers or a generalized masculine sex-role are better at mathematics than those who have a feminine identification. Results of studies which have attempted to assess this hypothesis are ambiguous. Black (1973) and Heilburn (1974) concluded that measure of general masculine or feminine identification for women was independent of sex of the parent with whom the child identified. However, Plank and Plank (1954) and Henning and Jardim (1976) found that the common thread which appeared to unify case studies of successful women was their identification with their fathers.

Attitudes Towards Oneself and Mathematics

The literature suggests there may be little difference between the general attitude toward mathematics of males and females in elementary and secondary schools (Aiken, 1970, 1976; Ernest, 1976; Fox, 1974, 1975b; Callahan, 1971). Differences seemed to be pronounced at the college level, with males showing a more positive general attitude toward mathematics (Aiken, 1972; Aiken and Dreger, 1961; Dreger and Aiken, 1957). At both the elementary and secondary levels, there appeared to be no sex difference with respect to preferences for mathematics compared with other school subjects (Aiken, 1970, 1976; Ernest, 1976; Fox, 1974, 1975b).

However, several studies indicated there may be differences between males and females with respect to self-concept, confidence and anxiety in mathematics. Evidence for sex differences with respect to math anxiety was unclear. Macoby and Jacklin (1974) noted that general anxiety appeared to be more common among females (possibly because they are more likely than men to admit their fears). Dreger and Aiken (1957) reported no sex differences on a measure of math anxiety among college students in basic mathematics courses. Tobias (1976) found math anxiety more prevalent in women and linked its roots to fear of failure, lack of parental role models and the curriculum emphasis in elementary school.

Fennema and Sherman (1976) did not distinguish between anxiety and confidence, considering it a single dimension. They found that at each grade level from 6 through 12, boys were significantly more confident in their abilities to deal with mathematics than girls.

Usefulness

Several studies have detected sex differences in the perceived usefulness of mathematics (Fennema and Sherman, 1976; Fox 1975b; Hilton and Berglund, 1974; Sherman and Fennema, 1976). The research of Fennema and Sherman (1976) and Hilton and Berglund (1974) indicated the presence of a relationship between sex differences in achievement and differences in perceptions of the usefulness of mathematics for making a living. These findings suggest that different male and female perceptions of the usefulness of mathematics may result from sex-typing of mathematics and careers.

Haven (1972) found that women who believed that high school mathematics would be useful in their future studies were much more likely to take advanced high school mathematics.

Parental Influence

Students' attitudes towards mathematics seem to be related to the students' perceptions of the attitudes and abilities of their parents. Poffenberger and Norton (1959) found that liking of mathematics was related to students' perceptions of fathers' liking of mathematics, having been good in mathematics and using mathematics in their jobs. These factors were significantly related to positive attitudes of sons, but not daughters.

Fennema and Sherman (1976) found students' perceptions of their parents' attitudes were related to the students' course-taking intentions. Parental expectations seemed to influence students' success in mathematics (Poffenberger and Norton, 1956, 1959; Hill, 1967) and parents did appear to have lesser expectations for daughters than for sons (Levine, 1976; Casserly, 1975).

Fox (1976) concluded that perception of fathers' expectations, but not fathers' attitudes or occupation, was related to achievement and course taking for girls. Studies investigating the relationship of maternal attitudes and expectations to the attitudes of sons and daughters showed different results. Poffenberger and Norton (1956,1959) found that college students' perception of their mothers' expectations for a high grade in mathematics was significantly related to positive attitudes for males and females. The perception of the mother's liking of mathematics was not. Burbank (1968) found that the mother's attitude was significantly related to attitudes of both sons and daughters.

Kaminiski (1976) examined the relationships between perceived parental evaluations, self-concept and taking twelfth grade mathematics. The influences of sex, IQ and SES were controlled. Perceived parental evaluations and self-concept of mathematical ability were strongly correlated with course taking. Females seemed to be "programmed" by both parents and themselves for lower performance in mathematics than males, and subsequently behaved consistently with these self and other concepts.

Peers

A considerable amount of evidence suggests that girls are seriously concerned about negative consequences of academic success, especially in mathematics. Horner (1968) postulated a "fear of success" hypothesis to explain women's lower academic achievement. In a review of studies over a seven-year period, Horner (1972) concluded that highly competent and achievement-motivated young women, when faced with a conflict between their feminine image and development or expression of competence, adjusted their behaviors to a sex role stereotype which appeared to be strongly internalized. Hawley (1972) found that women's career choices were differentially related to their perceptions of men's views of the feminine ideal. Women preparing for careers in traditionally male-dominated fields of mathematics and science believed men made little differentiation in male-female work roles. Solano (1976) measured the attitudes of average ability students toward mathematically gifted students by using an adjective check list. The peers saw gifted boys as no better or worse than themselves, but gifted girls were judged significantly less favorably than the gifted boys.

Husbands (1972) found a strong influence of male peers on the career aspirations of undergraduate women. Males had higher academic and career aspirations than females and these differences were greatest at high ability levels.

Lavach and Lanier (1975) investigated the motive to avoid success in high achieving junior high school girls. Results showed that when direct competition with boys existed, even these high achieving girls showed fear of success when competition existed in an area traditionally considered masculine. Entwisle and Greenberger (1972) found that male peers actually exerted social pressure on those girls whose career aspirations were still developing. They also found that attitudes towards career achievement of females were related to socioeconomic status. Problems of peer influence have caused some researchers to consider sex-segregation as an intervention strategy as well as early tracking of girls in advanced mathematics programs (Casserly, 1975; Farley, 1968; Fox, 1975a).

Counselors

Evidence exists which indicates that, at best, counselors have a neutral or negative effect on women who want to pursue mathematics or professional careers. Thomas and Stewart (1971) found counselors to be equally accepting of clients who wanted to pursue traditional and nontraditional careers, but they indicated the need for further counseling when the career was considered inappropriate (nontraditional).

Casserly (1975, 1979) found guidance counselors in schools offering advanced placement mathematics to be poor sources of encouragement. For example, Casserly reported, "Female counselors seemed to project their own anxieties and ignorance on the limited horizons of their (own) growth while some male counselors fear lest able, ambitious science-oriented women take away men's jobs. At the worst, some counselors of both sexes reject the possibility or propriety of the girls even getting that far and urge them 'to avoid discouragement or possible failure' by 'enjoying life' in greener, softer fields."[3]

Teachers

Many studies indicate that student attitudes toward mathematics are related to experience with teachers. Aiken (1972) concluded that teacher attitudes can influence student attitudes. Student perceptions of mathematics teachers as negative and demanding were significantly related to negative attitudes for both males and females. Girls, more frequently than boys, had positive attitudes towards mathematics when they had positive attitudes towards teachers.

Teacher stereotyping of mathematics may also be affecting student attitudes towards mathematics. Ernest (1976) asked 27 elementary school teachers (24 were female) "who did better in mathematics--boys or girls?" Forty-one percent felt boys did better while no one felt girls did better.

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[3] Patricia L. Casserly, "The Advanced Placement Teacher as the Critical Factor in High School Women's Decision to Persist in the Study of Mathematics," Paper presented at AERA, 1979, p. 4.

To check the accuracy of this stereotype, he tested for significant differences in performance (using grades) in University of California at Santa Barbara classrooms and found no sex differences. The cumulative exposure to attitudes which stereotype mathematics as more for males than females may well influence student behavior in later grades.

Indeed, Fennema and Sherman (1976) found that student perceptions of teachers' views of themselves as learners of mathematics were significantly related to future participation in mathematics courses.

Differential treatment by teachers of males and females may be another teacher behavior affecting student attitudes towards mathematics. Bean (1976) and Parsons (1979) reported differential interactions of teachers for male and female students in high school mathematics classrooms. Bean found teachers initiated fewer interactions with females than with males. Parsons found that in classrooms where teachers had no sex differences in expectancies for either males or females, females interacted more, answered more questions, received more work and praise and a lower portion of criticism. In contrast, the boys were given more praise and interacted more in classrooms taught by teachers who expected males to excel.

Casserly (1975) studied high schools offering advanced placement Calculus and Physics which had unusually high enrollments of women in these courses. She found that teachers of these courses had actively recruited girls for their courses and expected high levels of achievement. Luchins (1976) noted that many women successful in mathematics indicated they had at least one encouraging teacher during their schooling.

Summary

This brief review of studies pertinent to the Women and Mathematics issue indicates a clear lack of agreement regarding the effect of many of the variables on participation. Most studies reported looked at only a few of the possible factors affecting participation at one time. Sample sizes were small and results frequently inconclusive due to lack of statistical power. The contribution of the study reported here will be the determination of the relative importance of each of the possible factors affecting women's participation in mathematics as well as determining predictive models of participation and achievement.

CHAPTER III

PROCEDURES

Defining the Variables

Based on a thorough literature search, a tentative list of variables which may be affecting participation was developed. The variables were categorized into groups such as mathematics and oneself, parents' influence, career plans, stereotyping, influence of significant others, etc. Relevant research articles and existing instruments were reviewed by staff, and definitions of each variable were drafted. Based on this information, a rough first draft of scales or individual items for each of the variables of interest was prepared. Definitions of the final survey variables appear in Appendix A.

Review of the Variables and Instruments

A five-member advisory board was formed to give their reactions to products and plans and to advise the project staff. The board was comprised of three mathematics educators and two research psychologists. Their names and affiliations appear in Appendix G.

At subsequent meetings of the advisory board, definitions were refined and existing instruments were reviewed for accuracy, completeness, item quality and content validity. The advisors aided the development process by noting areas in which new items needed to be developed and recommending procedures for filling such gaps. After project staff and the advisory board agreed on the development which needed to be done, consultants were asked to edit existing items and write new items to measure the variables as they had been defined. Names and affiliations of consultants who worked on this project also appear in Appendix G.

Field Testing

In February 1978 all items and scales were field tested on approximately five hundred eighth grade and five hundred twelfth grade students from Duluth, Minnesota and Columbus, Georgia. Both males and females were tested. These sites were selected to represent the national mean, based on NAEP's sampling plan. Related scales and items were packaged together resulting in two test booklets which were administered to both ages. For example, all the items measuring self-confidence, anxiety, enjoyment and parental influence and encouragement were randomly included in the same package. This allowed the data to be analyzed by scales yielding inter-item as well as some inter-scale correlations. The LERTAP item analysis program and the SAS factor analysis program (principal components and a varimax rotation) were used.[1] Items with low item-to-scale correlations and small standard deviations were eliminated. This technique was used to develop short (ten to fifteen item) scales with high internal consistency.

Factor analysis was used to aid in the identification of separate variables in the "Mathematics and Oneself" category. Items addressed such constructs as anxiety, enjoyment and confidence. Self-concept as a learner of mathematics loaded on one factor which was called "confidence." Motivation items were combined with enjoyment items. Anxiety and confidence, although correlated, were distinct factors. Therefore, three "Mathematics and Oneself" scales used in the study relate to confidence, anxiety and enjoyment of mathematics.

Item Reviews

At another meeting, the advisory board reviewed the results of field testing and made recommendations for the inclusion of items in final scales based on: 1) a high item-to-scale correlation for both ages and both sexes (to increase scale reliability), and 2) a high standard deviation (indicating variability in responses) for both ages and both sexes. Size of differences between item means for different groups was not used as a basis for item selection.

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[1] LERTAP (Laboratory of Educational Research Test Analysis Package) is an item analysis program written by Larry R. Nelson, University of Colorado, Boulder. SAS (Statistical Analysis System) is from the SAS Institute, Raleigh, North Carolina, 1976.

These selection criteria did not take into account the "polarity" or direction of the response for items in scales. Classically, scales have as many positive items as negative items to prevent the respondent from getting into a response set when answering items in scales. During development, many items with good psychometric qualities were rewritten into a positive or negative direction to balance the number of positive or negative items within a scale. In many cases, when the new version was field tested, the item-to-scale correlations were significantly lower, thus changing the scale reliability. Final selection of items for scales depended more on the contribution of each item to the scale than on polarity. Thus, some scales are not balanced with respect to the polarity of items. However, the "response set" problem was not a threat in this study since items from many scales were packaged together randomly, and items with both positive and negative polarity were well-represented.

Consultants were brought in to review the selected items and fill in gaps where items had been deleted or refinements in the definition of the variable had been made. In April of 1978, the instruments were again field tested, this time on 900 eighth and eleventh grade students in Minnesota, Rhode Island and Connecticut. As in the first field testing, items measuring the same variable and scales in the same categories were packaged in the same booklet.

Final Selection

Following the April field tests, items were analyzed once again using LERTAP and the weaker items (based on item-to-scale correlations and standard deviations) were rejected. Also at this stage, items were rejected if they were repetitious. For example, the difference between two particular items may have been relatively minor due to slight variations in wording. By testing both, the more effective of the two items could be identified. Logical analysis also entered into the final selection of items in that consultants, staff and advisory board members wanted to be sure various aspects of variables were represented in the scales. For example, anxiety when in class, when taking tests and when doing mathematics would be components of anxiety toward mathematics and were included in the final scale.

Validation

A small validation study was conducted in local Denver schools during May of 1978. Teacher ratings of students were correlated with students' scale scores on three variables. Six teachers (junior and senior high school) were asked to rate the students in two or three of their mathematics classes (ranging from General Mathematics to Geometry) using a five-point scale for the variables of enjoyment, anxiety and confidence. Students responded to a brief questionnaire which included the items from these scales. Correlations between teacher ratings and student scores ranged from .39 to .70 for confidence, .26 to .50 for anxiety and .20 to .61 for enjoyment.

Instruments measuring other variables were not validated using this approach because 1) they attempted to measure a student's perceptions of such things as parental encouragement where the perception of encouragement is more important than reality, or 2) the items were background questions concerning such things as parental education or occupations.

Survey Questionnaire

The survey items were packaged into two separate booklets--one for the 13-year-old sample and one for the grade 12 sample. Items were organized into the following ten categories and items representing scales were randomly arranged within each section:

I. Attitudes
II. Mathematics Background
III. More Attitudes
IV. Computation
V. Problem Solving
VI. Parents' attitudes
VII. Algebra
VIII. Teachers' and Friends' Attitudes
IX. Space Relations
X. Careers

Appendix B includes the survey instruments used in this study. A code next to each item indicates the location of each item in the survey questionnaire. Source documentation for achievement items used by permission appears in Appendix C.

Sampling

The drawing of the survey sample and the administration of the questionnaire were performed under subcontract by the Research Triangle Institute (RTI) Raleigh-Durham, North Carolina. The sample was drawn in the early spring of 1978 and the survey administered between October 9 and December 15, 1978.

Two sample populations were surveyed--13-year-olds and high school seniors (grade 12). Both males and females were included in each sample. The survey was administered to these two age groups, in which there was approximately four years difference in age in an attempt to detect shifts or changes in attitudes and achievement in mathematics during the high school years. The 13-year-old sample, where most students were in the eighth grade, represented the end of compulsory mathematics in the junior high school. It is at about this time that students make a choice whether or not to pursue mathematics. The grade 12 sample was selected because it is the last grade in high school. Students would have taken (or be taking) all of the high school mathematics they could.

The sample was a national probability sample with an estimated standard error of national estimates of item performance of about two percent. A sample of 82 schools with group administration sizes ranging from 12 to 25 students participated in the 13-year-old sample administration; 1,452 13-year-olds were surveyed. Since the grade 12 sample was not the typical 17-year-old sample drawn by the NAEP, a separate sample was determined by RTI, consisting of 71 schools and 1,788 students. Up to 35 students per school were surveyed.

National Assessment uses a national probability sample at each age level to estimate the proportion of people who would successfully answer an item. The particular sample selected is one of a large number of all possible samples of the same size that could have been selected with the same sample design. Since an achievement measure computed from each of the possible samples would differ from one sample to another, the standard error of this statistic is used as a measure of the sampling variability among achievement measures from all possible samples. A standard error, based on one particular sample, estimates the sampling variability.

In the interest of sampling and cost efficiencies, a complex, stratified, multistage probability sample design was used. Typically, complex designs do not provide for unbiased or simple computation of sampling errors. A reasonably good approximation of standard-error estimates of acceptable response percentages is obtained by applying the jackknife procedure to first-stage sampling units within strata. Standard errors for achievement measure such as group differences, mean percentages or mean group differences for a particular assessment are estimated directly, taking advantage of features of the jackknife procedure that are generic to all of these statistics. More detailed information on the sampling plan and statistical techniques are found in Appendix F.

Oversampling of certain populations was done for the grade 12 sample, which accounts for the larger sample size. For obvious reasons, it was feared that there would not be enough females and possibly males who had taken advanced mathematics in a national probability sample to form a large enough group on which to make statistical comparisons. Students who had taken Trigonometry or higher mathematics courses were considered "advanced" and oversampled. Their student weights were adjusted so the sample was still nationally representative. A description of the procedure for selecting students in the oversample appears in Appendix F.

Administration

Once the sampling plan was determined and schools contacted for participation and scheduling, RTI personnel administered the survey booklets to eligible students in the selected schools. Students were given a survey booklet containing the items and a separate answer sheet on which to respond. Students were paced through the 90-minute survey by an audio tape to assure that students would finish answering all questions and to put a time limit on the achievement subtests.

A principal's questionnaire and a supplementary principal's questionnaire were administered to each school in the sample. The principal's questionnaire collected information from which some background variables were determined (e.g., school enrollment). The supplementary principal's questionnaire was specific to this study and collected information on mathematics graduation requirements, student plans for college attendance, mathematics course offerings and mathematics course enrollment data by sex.

Answer sheets were shipped to Westinghouse Data Score Systems where they were scanned along with the principal's questionnaire and the results put on computer tapes. A weight for each respondent was computed by RTI and these data merged onto the data tape.

The weighted tape was then sent to ECS for analysis. A package score program was developed at NAEP to handle scale scores and missing values for input into the computer package, SPSS, and the NAEP data management system.[2]

Description of Instruments

The survey instruments were designed to measure the variables previously listed. The list and the definitions of variables appear in Appendix A, and the instruments themselves and internal consistency estimates appear in Appendix B. Definitions were based on information obtained through the literature review and discussions with members of the advisory board and other consultants.

Various paper and pencil formats were used for the survey instruments. Scales were assessed using five option Likert items (Strongly Disagree to Strongly Agree). Items from different scales were interspersed throughout certain sections of the survey. The number of negatively and positively stated items in each scale are not equal, but are approximately equal when all scales are combined. Response options for each of the Likert items were assigned values of one to five with five representing a strong positive attitude toward mathematics. For example, the "Strongly Agree" response was always given a value of five on the raw data tape, but was later weighted in the direction of its contribution to a positive attitude toward mathematics and/or participation. For example, a high score on stereotyping items or scales indicated a "contemporary" attitude, that is, no stereotyping. A high score on the anxiety scales indicated low anxiety since a low level of anxiety contributes to a positive attitude toward mathematics and participation. Interpretation of scores for items and scales also appears in Appendix A.

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[2] NIE et al., SPSS Statistical Package for the Social Sciences (McGraw-Hill, 1975).

Scale scores were computed by 1) determining the polarity of each item such that the most positive response had the highest value (for example five on a Likert item), 2) dividing the student's actual response by the maximum value (for example, if a student answered "Undecided," which has a value of three on a Likert scale, it was divided by five, the maximum response, giving a score of 3/5 or .60. For scale scores, students had to answer at least half the items in the scale to get an average response or score on the scale). This technique of basing scores on 100% was used so that scores could be compared across scales with unequal numbers of items. The same method was used to give scores on individual Likert items.

Description of Variables

The first category of variables, general sex-role stereotyping, was measured by three Likert scales of six, eight and ten items. General sex-role stereotyping dealt with attitudes towards the dual role of women, spousal responsibilities and equality of the sexes. The second stereotyping scale measured students' perceptions of mathematics as a male domain--that is, as a field of study and work appropriate only for men. The third scale looked at men's attitudes toward women who are successful in mathematics.

Career plans constituted the second category of variables. Students were asked to choose the career they planned to have from a list of eight groups or categories of careers (modified from Coleman, 1966). After they selected a career, they were then asked how much mathematics they thought they would need for their chosen career. Finally, they were asked to rate the importance of a list of factors which might have affected their decision about taking a particular job.

Attitudes towards mathematics and school were measured by five scales. Confidence in mathematics was an eight-item scale measuring students' perceptions of how good and confident they were in mathematics or whether they had the potential to be good in mathematics. A ten-item anxiety scale dealt with students' feelings of uneasiness when doing mathematics, taking mathematics tests or working problems.

Since anxiety can frequently be related to other things besides mathematics, two more short scales were developed to measure general anxiety about school in general and about English class. The intended purpose of these two additional measures was to differentiate students who were generally anxious (high anxiety on all scales) from those who were anxious only in mathematics.

The enjoyment of mathematics scale (eight items) included items which surveyed students' liking of mathematics.

The fourth category of variables included a single scale, usefulness of mathematics to the individual. Two components of usefulness were addressed--usefulness of mathematics in daily life and usefulness of mathematics to career and educational plans.

Three items surveyed students' academic plans. One item asked students to select from a list the highest level of education he or she expected to complete (from graduating from high school to attending graduate or professional school). The second item in this category was specific to 13-year-olds. It asked how many years of mathematics they planned to take during four years of high school. Since 13-year-olds have had little or no choice regarding mathematics course selection in their current grade, this variable was used as the dependent variable for their participation in mathematics. Another series of items on course taking was used as the dependent variable of participation for the grade 12 sample and is described below under school experience.

Finally, under academic plans, a set of questions asked students to indicate the importance of nine different factors affecting their course-taking decisions. These items were intended to directly measure the relative imporatance of many of the factors which the other survey items address more inobtrusively in scales (e.g., parental, teacher or counselor influence, confidence or enjoyment of mathematics, etc.).

Two scales and seven individual items dealt with the sixth variable category, parental influences. Mothers and fathers were treated separately with parallel items in separate scales. Research has indicated parents have a strong influence on their children's attitudes, including attitudes regarding educational aspirations, career aspirations and course taking. Influence was analyzed as two factors--a passive type of influence through role modeling and a more active influence through direct encouragement.

A short, three-item scale measured the importance of mothers and fathers as role models in mathematics. Items checked student perceptions of mothers' and fathers' feelings toward abilities in and frequency of use of mathematics. These items were intended to measure a passive of indirect influence of parents by the example in mathematics the parents, themselves, set.

Active or direct encouragement by parents was surveyed by an eight-item scale asking student perceptions of their parents encouragement regarding mathematics. Items dealt with student perceptions of their parents' views of them as learners of mathematics.

Parents stereotyping of mathematics was a single set of parallel items which determined whether or not students believed their parents thought "mathematics is more for males than females." The same item was asked regarding friends and teachers, as well.

A single item determined which parent helped the student more with mathematics homework.

Students were asked what their parents' education expectations for them were. The educational choices were the same as for the item the student responded to for his own educational aspirations.

Two items ascertained the family (marital) status. Different results might be expected on parental influence scales for children of single-parent families. So that family status could be controlled in analyses of parental influences, a question asked if the student lived with mother, father or both parents and a second question asked if they see the parent they don't live with often, indicating an opportunity for influence.

The influences of the seventh category, significant others, was measured by three scales and five individual items. Peer influence was surveyed by a ten-item scale which got at what one's friends thought about people who are good in mathematics, whether one tries to hide one's success in mathematics or whether one tries to avoid success in mathematics altogether. Peer stereotyping of mathematics was measured by two parallel items similar to the parents stereotyping of mathematics items. These items asked whether boys and girls among their friends thought mathematics was more for males than for females.

Counselor encouragement was determined by a single item asking to what degree a counselor had encouraged or discouraged them from taking mathematics, or if they had been counseled at all.

Teacher encouragement was measured by an eight-item scale which obtained measures of students' perceptions of their teacher's direct encouragement to take more mathematics, teachers' opinions of them as learners of mathematics, and perception of teachers' confidence in their ability in mathematics. Earlier research suggested that teachers behave differently toward male students than toward female students. A ten-item scale measured teacher differential treatment, looking at students' perceptions of teachers' differential expectations, encouragement and possible favoritism for males versus females.

Siblings were another group of "significant others" who may have been affecting participation. The presence of an older brother or sister who is good in mathematics was determined through two questions. The older sibling may generate a competitive situation for success in mathematics or may be encouraging the young sibling to take mathematics.

Information was collected on a number of background variables. For the twelfth grade sample, mathematics participation was determined by asking respondents to indicate which of eleven mathematics courses they had taken. Courses ranged from General, Business or Consumer Mathematics to Pre-Calculus and Calculus. Based upon which level a student terminated his or her mathematics coursework, each was placed into one of four categories ranging from low participation to high participation. Students in the lowest participation group completed no mathematics higher than Algebra I. Students in participation group two completed Algebra II and/or Geometry. To be classified into group three students had to complete Trigonometry and/or Probability/Statistics and for group four, the highest participation group, Pre-Calculus or Calculus. Approximately equal numbers of students fell into each of these four groups because the higher mathematics courses had been oversampled in the sampling design.

Students were then asked if they took (for the grade 12 sample) or if they are presently taking (for the 13-year-old sample) algebra while in eighth grade. This variable was included since algebra in the eighth grade could represent "fast tracking" in mathematics. If there was a differential enrollment for the sexes at this early point in their mathematics careers, it might be a starting point for the disparity in course taking for males and females.

For additional background information, high school seniors were asked what type of high school program they had taken--general, vocational-technical or college preparatory.

Another item asked students to identify the grade they had typically received in mathematics.

Achievement in mathematics was assessed by four separate subtests measuring computation, algebra, problem solving and spatial visualization. These four were selected because of previously noted differences between the sexes on varying cognitive levels and spatial ability. Fourteen items comprised the computation subtest and were selected from the Stanford Achievement Test (exact source information is located in Appendix C). Thirteen-year-olds were administered six items from the Cooperative Algebra I test and the seniors were administered sixteen items from the same test. Problem solving consisted of twelve items for 13-year-olds and fourteen items for seniors from the Metropolitan Achievement Test. Selection of items from these three tests was based on item analysis statistics (high discrimination) available from a previous study of about two thousand high school students in the mid-west. The spatial visualization subtest was composed of fifteen randomly selected items from the Minnesota Paper Form Board. An achievement composite score was developed by summing and averaging student scores on the computation, algebra and problem-solving subtests.

All cognitive subtests were timed through the use of an audio pace-tape.

A measure of socioeconomic status (SES) was devised by using a composite of mother's and father's occupation, education and items in the home. Categories for occupations were the same as those used for career plans of the respondents. There were five categories of educational attainment ranging from "Did not graduate from high school" to "Attended a graduate or professional school." Items in the home consisted of eleven items (e.g., newspaper, typewriter, color television) which respondents indicated they had or did not have in their home. Factor analysis indicated a nearly equal factor loading for the five factors so they were given equal weight in the composite SES measure.

Analysis of Survey Data

Data analyses were performed to provide statistical evidence to answer the following research questions:

1. To what extent do sex differences exist for mathematics achievement for twelfth grade and 13-year-old students?

2. To what extent do sex differences exist for mathematics participation for twelfth grade **students** and for intended mathematics participation for 13-year-old students?

3. To what extent do sex differences exist for mathematics achievement for twelfth grade students when compared within levels of participation?

4. To what extent do sex differences exist when students are asked to rate the importance of selected study variables in their decision to take more mathematics?

5. To what extent do sex differences exist on attitudinal and background variables when means for study variables or frequencies of responses are compared by sex and within levels of mathematics participation and achievement?

6. To what extent do study variables correlate with participation and achievement for male and female twelfth grade and 13-year-old students?

7. What relationships exist between the dependent variables of mathematics participation and achievement and selected predictor variables?

Results for questions 1-6 will be discussed in Chapter IV. The rationale for and results of the regression analyses (Question 7) appear in Chapter V.

CHAPTER IV

DESCRIPTIVE RESULTS

Sex Differences in Achievement

Achievement data for both student populations are summarized in Table 1. A national mean (males and females combined), standard errors and sample size are given for each of the four achievement subtests and the achievement composite. In addition, means, standard errors and sample sizes are given for males and females separately. To test for a significant sex difference in means, the standard error of the sex difference is estimated by the square root of the sum of squared standard errors for the two means. With sample sizes of this magnitude, t is distributed approximately as z. Significant differences at the .05 and .01 level are indicated.

The pattern of results for the high school seniors and 13-year olds on achievement subtests is similar to trends reported in previous surveys. Sex differences in achievement for the twelfth grade sample were evident only on the problem-solving subtest and the achievement composite measure. Males scored approximately seven percentage points higher on the problem-solving subtest. There was about a five percent advantage for males on the achievement composite measure. It is interesting to note that there were no significant sex differences on the spatial visualization measure, which previous studies indicated may exist.

For the 13-year-olds, females outperformed males on the computation subtest, a finding which earlier research corroborates. Females were evenly matched with males on problem-solving ability, but surpassed their male counterparts on the spatial visualization test by five percentage points (significant at the .01 level).

TABLE 1

MATHEMATICS ACHIEVEMENT
FROM WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978
PERCENTAGES OF CORRECT RESPONSES BY SEX AND AGE LEVEL

		Grade 12				Age 13			
Achievement Test		**National**	**Male**	**Female**	**Difference**	**National**	**Male**	**Female**	**Difference**
Computation (14 items) (From the Stanford Achievement Test)	%	64.79	65.67	64.01	1.66	50.95	48.28	53.58	-5.30*
	S.E.	1.38	1.46	1.73	2.26	1.35	1.40	1.55	2.09
	n	1777	862	915		1423	705	718	
Algebra (16 items--Grade 12) (6 items--Age 13) (From the Cooperative Algebra I Test)	%	52.64	55.45	50.18	5.27	32.35	30.85	33.81	-2.96
	S.E.	1.94	1.89	2.15	2.86	.99	.98	1.24	1.58
	n	1723	827	896		1341	664	677	
Problem Solving (14 items--Grade 12) (12 items--Age 13) (From the Metropolitan Achievement Test)	%	68.42	72.09	65.16	6.93**	50.67	50.69	50.65	.04
	S.E.	1.21	1.32	1.32	1.87	1.05	1.07	1.35	1.72
	n	1778	860	918		1420	703	717	
Spatial Visualization (15 items) (From the Minnesota Paper Form Board)	%	70.27	71.26	69.40	1.86	54.05	51.50	56.56	-5.06**
	S.E.	1.15	.98	1.59	1.87	.99	1.20	1.09	1.62
	n	1712	829	883		1368	676	692	
Achievement Composite (44 items--Grade 12) (32 items--Age 13) (Total of Computation, Algebra and Problem Solving)	%	61.63	64.13	59.43	4.70*	47.14	45.80	48.46	-2.66
	S.E.	1.44	1.45	1.66	2.20	1.07	1.03	1.28	1.64
	n	1773	857	916		1414	700	714	

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* $p < .05$
** $p < .01$

Looking at the means on the achievement measures for 13-year-olds and high school seniors, a shift in performance for the sexes is evident. For 13-year-olds, on the two subtests where there were significant sex differences in performance, both differences were in favor of the females. For the seniors, differences in performance on the two achievement measures were in favor of the males. At age thirteen, women appear to have comparable or even superior mathematical abilities as men.

In addition to the results on the achievement subtests from this Women and Mathematics study, selected results from the recent National Assessment of Educational Progress' Second Mathematics Assessment (conducted during 1977-78) are reported in Table 2. This assessment used a large national sample of 9-, 13- and 17-year olds. Summary results of exercise sets on computation (127 items), algebra (59 items), and application (136 items) are reported for approximately 24,000 13-year-olds and 24,000 17-year-olds. Although these exercise sets purportedly measure the same mathematical skills, they are not the identical items which appeared in the standardized tests chosen for this Women and Mathematics study. Another difference is that students in the older sample in the Women and Mathematics study were in grade 12, not a 17-year-old sample which the NAEP assesses. Typically in the NAEP assessment, about 72% of students are in grade 11 and only about 14% are in grade 12. Results from the NAEP Second Mathematics Assessment are reported here because they are current, represent a very large national probability sample and substantiate the pattern of sex differences in achievement found in this study.

The results for 17-year-olds on comparable measures from the NAEP Second Mathematics Assessment are similar to the results for the Women and Mathematics study. No significant sex-related differences existed for computation or algebra (no measure of spatial ability was included) but a large and statistically significant difference of five percentage points existed in favor of males on the application (problem solving) exercise set. Again, 13-year-old females did significantly better than males on computation items. One difference in results between the two surveys is that 13-year-old males outscored females on problem-solving skills in the larger NAEP assessment. The difference was not large and the

TABLE 2

MATHEMATICS ACHIEVEMENT
FROM THE NAEP SECOND MATHEMATICS ASSESSMENT, 1977-78
PERCENTAGES OF CORRECT RESPONSES BY SEX AND AGE LEVEL

		Age 17				Age 13			
Objective		National	Male	Female	Difference	National	Male	Female	Difference
Computation	%	67.17	67.65	66.72	.93	51.68	49.94	53.44	-3.50**
(127 items--Age 17)	S.E.	.58	.62	.62	.88	.74	.78	.77	1.10
(129 items--Age 13)	n	24,606	11,983	12,623		24,196	12,079	12,117	
Algebra	%	39.99	40.87	39.14	1.73	52.17	51.29	53.07	-1.78
(59 items--Age 17)	S.E.	.59	.70	.58	.91	.72	.74	.77	1.14
(43 items--Age 13)	n	24,605	11,975	12,630		24,193	12,077	12,116	
Applications	%	43.48	46.06	41.02	5.04**	43.34	44.13	42.53	1.60*
(136 items--Age 17)	S.E.	.49	.53	.53	.75	.50	.53	.53	.75
(106 items--Age 13)	n	24,609	11,982	12,627		24,190	12,075	12,115	

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* $p < .05$
** $p < .01$

difference was significant only at the .05 level. With a sample of this size, even very small differences in performance are detected.

Results from the two surveys indicate the same pattern of performance for the two sexes and two ages. Females enter high school with the same mathematical understanding and skill as the males. Sometime during the high school years, men catch up with and then surpass the females in certain areas of mathematics achievement. Is this phenomenon easily explained by the notion that men take more mathematics while in high school and thus have higher achievement scores? Some insight into this hypothesis can be obtained by looking at high school mathematics participation for both males and females.

Sex Differences in Participation

Results of mathematics participation in high school are summarized in Table 3 for grade 12 students. Percentages of students who indicated they had completed, or were presently taking, each of twelve high school mathematics courses are given. Standard errors, the difference in percentages for each sex and the standard error of the difference are also reported. These data represent results from students' self reports. School records were not checked to substantiate student responses.

Few sex differences in mathematics participation were found for the lower level high school mathematics courses. Only three of the possible twelve courses showed significant differences in enrollments. Females took more Business and Accounting Mathematics; males took more Algebra II and Probability/Statistics. Almost four percent more men took Trigonometry, five percent more men took Computer Programming and more than three percent more men took Calculus, although none of these differences were significant.

Enrollment statistics for 17-year-olds are reported for the NAEP Second Mathematics Assessment in Table 4. It is important to remember that this is a 17-year-old sample and that most students are in the eleventh grade. They have not had the opportunity to take as much mathematics as the high school seniors reported in Table 3. Because of this, the total percent for course enrollments is somewhat lower. In general, the trends in participation are similar, but some differences do exist.

TABLE 3

MATHEMATICS PARTICIPATION OF GRADE 12 STUDENTS
FROM WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978
PERCENTAGES OF STUDENTS BY SEX PRESENTLY TAKING OR HAVING COMPLETED EACH COURSE

		National	Male	Female	Differences
General Math	n	1786	868	918	
	%	89.41	90.12	88.77	1.35
	S.E.	1.51	1.40	2.16	2.57
Accounting/Business Math	%	36.61	32.62	40.21	-7.59*
	S.E.	1.61	2.31	2.73	3.58
Consumer Math	%	26.96	28.78	25.32	3.46
	S.E.	2.45	3.33	2.92	4.43
Pre-Algebra	%	65.03	65.08	64.98	.10
	S.E.	2.39	2.71	3.28	4.25
Algebra I	%	79.71	81.06	78.49	2.57
	S.E.	2.47	2.58	3.07	4.01
Geometry	%	57.22	59.36	55.29	4.07
	S.E.	3.14	3.40	3.42	4.82
Algebra II	%	47.63	53.72	42.15	11.57*
	S.E.	3.44	3.76	3.55	5.17
Trigonometry	%	28.95	30.96	27.14	3.82
	S.E.	2.01	2.60	2.93	3.92
Probability/Statistics	%	7.05	9.48	4.86	4.62*
	S.E.	.91	1.61	.84	1.82
Computer Programing	%	15.59	18.16	13.28	4.88
	S.E.	2.36	3.22	2.20	3.90
Pre-Calculus	%	19.65	21.49	18.00	3.49
	S.E.	1.60	2.31	1.93	3.01
Calculus	%	7.69	8.20	7.23	.97
	S.E.	1.18	1.64	1.20	2.03

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*$p < .05$

TABLE 4

MATHEMATICS PARTICIPATION OF 17 YEAR OLD STUDENTS
FROM THE NAEP SECOND MATHEMATICS ASSESSMENT, SPRING, 1978
PERCENTAGES OF STUDENTS BY SEX WHO HAVE STUDIED EACH COURSE

		National	Male	Female	Difference
General, Business or Consumer Math	n %	24,314 45.6	11,834 44.3	12,480 46.8	-2.5
Pre-Algebra	%	45.8	46.4	45.3	1.1
Algebra I	%	72.1	70.7	73.6	-2.9
Geometry	%	51.3	52.1	50.5	1.6
Algebra II	%	36.9	37.8	36.1	1.7
Trigonometry	%	18.7	20.5	16.9	3.6*
Probability/Statistics	%	8.7	9.8	7.7	2.1
Computer Programming	%	9.3	10.4	8.2	2.2
Pre-Calculus/Calculus	%	5.3	6.2	4.4	1.8*

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*$p < .05$

Significant sex-related differences in enrollments were found for the higher level mathematics courses, Trigonometry and Pre-Calculus/Calculus. Although only 3.6% more males took Trigonometry, this percent difference represents a 55%-45% male-female enrollment split. Similarly, the fact that only 1.8% more men took either Pre-Calculus or Calculus can be somewhat deceiving since this represents almost a 3:2 ratio of men to women in these higher level courses. Fully 60% of the students in Pre-Calculus/Calculus are men and only 40% are women, according to the NAEP survey. The finding that 3.5% more males took Pre-Calculus in the Women and Mathematics study may reflect a reliable difference which might have been significant if a larger and statistically more powerful sample had been drawn.

When additional analyses were performed to compare the percentage of men and women who took four years of academic high school mathematics, slight differences persist. Forty-one percent of the males and 37% of the females have taken Algebra I, Algebra II, Geometry and any one of the remaining courses: Trigonometry, Probability/Statistics, Pre-Calculus or Calculus to make up the typical four-year mathematics sequence. The difference in percentages changes very little when analyses are done for students who report they are in an academic or college preparatory program, rather than a general or vocational program (27% v. 24%).

For 13-year-olds, the reported number of years they might take mathematics in high school is summarized in Table 5. This is an intended, rather than actual participation measure and is therefore not as valid a measure as the one used for the grade 12 sample. Even though intended participation is not as valid a measure of participation as the one used for the 12th grade sample, it is interesting to note that about 50% of the 13-year-olds plan to take four years of high school mathematics compared with the 40% of the seniors who actually did take four years of mathematics. More males than females intended to take only one year of mathematics in high school, but approximately the same number of women as men intend to take two, three or four years of high school mathematics. There are no differential rates of intended participation for the presumably more advanced courses for 13-year-olds.

The widely disparate sex differences in participation reported by

TABLE 5

INTENDED MATHEMATICS PARTICIPATION FOR 13 YEAR OLD STUDENTS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. PERCENTAGES OF STUDENTS BY SEX WHO INTEND TO TAKE HIGH SCHOOL MATHEMATICS COURSES

Intended Mathematics Participation (Number of Years of High School Mathematics Students Intend to take)	Male	Female	Difference
None	5.41	2.72	2.69
	1.09	.91	1.42
1 Year	8.13	4.44	3.69*
	1.23	.91	1.53
2 Years	15.57	18.89	-3.32
	1.50	1.58	2.18
3 Years	22.82	22.48	.34
	2.20	1.63	2.74
4 Years	46.07	50.35	-4.28
	1.91	1.80	2.62

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*$p < .05$

Sells (1973) and Ernest (1976) seem to be diminishing. Although there are some discrepancies in sex differences in participation for certain courses between the two surveys reported here, the patterns are the same. Participation for males and females is similar for the "core" courses of Algebra and Geometry, but slight differences exist favoring males at the higher level courses, at least in the NAEP assessment.

Are sex differences in mathematics participation large enough to account for the observed sex differences in achievement? Had males taken considerably more mathematics than females, a difference in performance would have been expected as a result. But the differential rates of participation appear to be slight compared with the differential scores on certain achievement tests. Some insight into the question of the effect of participation on sex differences in achievement may be provided by looking at achievement scores for males and females within levels of mathematical participation.

Sex Differences in Achievement Within Participation Levels

Scores on the four achievement subtests and the one achievement composite measure are reported in Table 6 for males and females within seven different participation groups. These groups are defined by the highest mathematics course taken when in high school and can be thought of as a student's stopping point in his or her mathematics education. Wherever possible, a single course was used to define a level so that the definition would be as exact as possible.

Achievement subtest scores, sample size, standard errors, the difference in scores between sexes, and the standard error of the difference are given for each of the several levels of participation.

No statistically significant sex-related differences existed on the computation or algebra achievement tests for any level of mathematics participation. Differences did appear in favor of males on the problem-solving measure in four of the seven participation levels. Males in the two lowest participation groups and males who stopped at either Algebra II or Trigonometry outperformed females on the problem-solving test. No significant differences in achievement appeared at the higher participation levels of Pre-Calculus or Calculus.

TABLE 6

MATHEMATICS ACHIEVEMENT WITHIN PARTICIPATION LEVEL FOR GRADE 12 STUDENTS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978 PERCENTAGES OF CORRECT RESPONSE BY SEX

Level of Participation		Computation			Algebra		
		Male	Female	Difference	Male	Female	Difference
General Math, Business Math, Consumer Math, Pre-Algebra	%	47.50	48.05	- .55	31.23	25.40	5.83
	S.E.	1.97	2.53	3.20	1.51	2.68	3.08
	n	116	119		95	109	
Algebra I	%	56.21	58.05	-1.84	32.39	35.73	-3.34
	S.E.	2.30	2.50	3.40	2.13	1.50	2.61
	n	114	145		108	142	
Geometry	%	60.59	63.09	-2.50	46.37	44.90	1.47
	S.E.	3.38	2.72	4.34	5.42	2.95	6.17
	n	55	101		54	99	
Algebra II	%	70.87	67.04	3.83	64.50	57.20	7.30
	S.E.	1.58	3.51	3.85	2.71	3.61	4.51
	n	113	122		133	121	
Trigonometry and/or Probability/Statistics	%	70.40	68.34	2.06	60.32	64.89	-4.57
	S.E.	2.89	2.58	3.87	2.87	2.54	3.83
	n	161	167		157	165	
Pre-Calculus	%	77.78	76.76	1.02	75.04	70.30	4.74
	S.E.	1.81	2.17	2.83	2.14	3.18	3.83
	n	192	175		191	175	
Calculus	%	80.59	86.21	-5.62	80.85	83.10	-2.25
	S.E.	2.57	1.68	3.07	2.72	2.34	3.59
	n	110	84		109	83	

(This Table is continued on the next page.)

TABLE 6 (CONT.)

Level of Participation		Problem Solving			Spatial Visualization			Achievement Composite		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
General Math, Business Math, Consumer Math, Pre-Algebra	%	58.49	51.20	7.29*	63.77	56.89	6.88*	46.13	41.38	4.75
	S.E.	2.16	2.58	3.36	2.55	1.50	2.96	1.23	2.12	2.45
	n	115	121		111	117		112	120	
Algebra I	%	66.11	60.10	6.01*	68.15	65.31	2.84	51.34	51.20	.14
	S.E.	2.10	1.94	2.86	4.91	1.94	5.28	1.74	1.63	2.38
	n	115	145		109	142		114	144	
Geometry	%	68.36	66.15	2.21	66.08	73.71	-7.63	57.95	57.84	.11
	S.E.	3.26	1.82	3.73	3.09	2.33	3.87	3.44	2.02	3.99
	n	55	102		51	99		55	102	
Algebra II	%	76.27	64.39	11.88*	72.56	69.90	2.66	70.27	62.53	7.74*
	S.E.	2.01	2.88	3.51	2.63	2.77	3.82	1.73	2.81	3.30
	n	113	122		111	115		113	122	
Trigonometry and/or Probability/Statistics	%	73.52	67.23	6.29*	71.35	74.23	-2.88	67.58	66.64	.94
	S.E.	1.91	1.77	2.60	2.46	1.78	3.04	2.39	2.10	3.18
	n	162	167		154	160		162	167	
Pre-Calculus	%	81.87	79.68	2.19	79.64	77.29	2.35	78.01	75.31	2.70
	S.E.	1.58	2.60	3.04	1.27	2.75	3.03	1.69	2.33	2.87
	n	190	175		186	166		191	175	
Calculus	%	86.49	85.52	.97	78.34	79.96	-1.62	82.60	84.71	-2.11
	S.E.	2.79	1.98	3.42	2.42	2.15	3.24	2.59	1.84	3.18
	n	109	84		107	82		109	84	

*p<.05

For the spatial visualization tests and achievement composite measure, only one statistically significant sex difference was found for each test. In the lowest participation level, males scored higher than females on the spatial tests. Males who stopped taking mathematics after Algebra II scored higher than females on the achievement composite measure. In summary, sex-related differences in achievement appear to exist within participation levels for the more difficult cognitive task of problem solving except at the highest levels of participation.

The large NAEP sample of 17-year-olds also showed sex differences in achievement within mathematics participation levels. Results are presented in Table 7 and indicate persistent sex differences favoring males at every level of participation on the application (problem solving) set of items. What is even more striking is the increase in the size of the sex difference as the level of mathematics participation increases. The mean difference in scores between males and females increases from a 2.5% difference favoring males at the lowest level of mathematics participation to almost 7.5 percentage points at the highest level. Achievement results on problem-solving within levels of mathematics participation indicate similar, although not identical, trends based on the results of these two independent surveys.

Interpreting these results is difficult. Based on the achievement scores for 13-year-olds, women start out in high school mathematics on par with men. For most participation groups, women do as well as men on tests measuring the skills of computation and algebra. But even when differences in participation are taken into account, men at nearly every level of participation have an edge in solving classic one- and two-step word problems.

Tables 1-7 have presented data to give a national picture of achievement and participation in mathematics for male and female 13-year-olds and high school seniors. Additionally, this study collected information on students' attitudes which may have been affecting their decision to take more mathematics. As an introduction to the discussion of factors affecting participation, the results of a single question answered by students are discussed below.

TABLE 7

MATHEMATICS ACHIEVEMENT WITHIN PARTICIPATION LEVELS FOR 17-YEAR-OLD STUDENTS FROM THE NAEP SECOND MATHEMATICS ASSESSMENT, SPRING, 1978 PERCENTAGES OF CORRECT RESPONSES BY SEX

Level of Participation

Objective		General Mathematics			Algebra I			Geometry			Algebra II			Higher Course than Algebra II		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
Computation (127 items)	%	47.03	48.32	-1.29	62.25	61.51	.74	70.66	69.35	1.31	80.44	78.08	2.36**	88.27	86.41	1.86
	S.E.	.82	.83	1.16	.90	.76	1.17	.78	.75	1.13	.69	.59	.90	.55	.58	.80
	n	2500	2534		1631	2176		1588	1920		2619	2890		1539	1139	
Algebra (59 items)	%	22.79	21.96	.83	31.44	30.33	1.11	37.93	37.62	.31	52.83	52.18	.65	69.02	65.56	3.46*
	S.E.	.36	.44	.57	.64	.55	.85	.75	.65	.99	.81	.75	1.08	1.05	1.19	1.58
	n	2501	2536		1629	2179		1588	1920		2618	2892		1539	1139	
Application (136 items)	%	30.39	27.95	2.44**	38.93	34.53	4.40**	48.07	43.53	4.54**	55.06	48.73	6.33**	67.69	60.29	7.40**
	S.E.	.48	.37	.61	.72	.61	.94	.70	.52	.87	.74	.65	.97	.66	.94	1.15
	n	2500	2534		1632	2176		1587	1919		2617	2891		1539	1139	

*p <.05
**p <.01

Relative Importance of Certain Factors Affecting the Decision to Take More Mathematics

What do students perceive as the most important factors affecting their decision to take more mathematics than is required while in high school? Students were asked to rate the importance of each of nine factors which may have affected their decision. Results were scored and then rank ordered by age and sex and are presented in Table 8.

Males and females in grade 12 indicated that the same factors were important in deciding whether or not to take more mathematics. Both sexes found the usefulness of mathematics to be the most important factor. Confidence and enjoyment of mathematics were also highly ranked. The influence of mathematics teachers, parents and school counselors were moderately important. Females perceived they were influenced more by their mother than father. Males ranked the influence of both parents about the same. Factors which seemed unimportant were related to peer influence, e.g., whether their friends took mathematics and whether their friends approved of their doing so. Slight shifts in the rank order of factors by males were evident, but in most cases the difference in means of these shifts were not significant.

Thirteen-year-old females rated the importance of the nine factors the same as the males. Like high school seniors, usefulness of mathematics was considered the most important factor and peer influence or approval the least important. Self-confidence in mathematics was seen as equally important by both ages, but was ranked second by the seniors and fifth by the 13-year-olds. Parents and teachers were reported to have had a greater influence on the decision by 13-year-olds to take more mathematics than on the seniors.

The importance of this rank order list of factors in Table 8 is twofold. First, it gets at the relative importance of certain factors affecting the decision to take more mathematics for each of the different groups. Second, it gives the first clues as to which factors are important in terms of future intervention efforts. What is interesting is that males and females within each age group rated the importance of the factors virtually identically. It appears for the most part that factors which affect the decision to take more mathematics are the same for men as well as women.

TABLE 8

RANK ORDERED RESULTS ON THE RELATIVE IMPORTANCE OF CERTAIN FACTORS AFFECTING STUDENTS' DECISIONS TO TAKE MORE MATHEMATICS

Factors	Grade 12 Females		Grade 12 Males	
	Mean	Rank Order	Mean	Rank Order
1. How useful mathematics will be	80.91	1	79.27	1
2. How good or bad in mathematics	74.55	2	68.81	3
3. How much math is liked or disliked	72.43	3	69.20	2
4. What math teachers think	66.40	4	64.63	4
5. What mother thinks	65.73	5	63.03	6
6. What father thinks	62.51	6	64.19	5
7. What school counselor thinks	56.27	7	55.69	7
8. Whether friends take math	25.12	8	31.83	8
9. Whether classmates approve	16.48	9	24.89	9

	Age 13 Females		Age 13 Males	
	Mean	Rank Order	Mean	Rank Order
1. How useful mathematics will be	88.15	1	82.54	1
2. What mother thinks	79.40	2	77.12	2
3. What father thinks	77.41	3	76.45	3
4. What math teachers think	76.38	4	73.57	4
5. How good or bad in math	72.87	5	69.47	5
6. How much math is liked or disliked	72.62	6	67.98	6
7. What school counselor thinks	63.86	7	62.06	7
8. Whether friends take math	45.43	8	43.72	8
9. Whether classmates approve	35.05	9	42.21	9

Looking at sex-related differences in attitudes may be another way of identifying factors which affect participation. This has frequently been done in the past but there are disadvantages to this technique and they will be discussed in the following section.

Sex Differences in Attitudes and Backgrounds Within Participation and Achievement Levels

Appendix E contains supplementary tables for the grade 12 and 13-year-old sample giving means of responses to survey variables for 1) each sex and combined national results, 2) each sex within participation levels, and 3) each sex within achievement levels. These data are included because they provide normative data for each sex and age level. These may be of interest to secondary users of these data who may wish to compare their results with national statistics.

It is important to make a point about sex differences on suspected causal variables. Reporting significant sex differences for each variable may be inherently interesting, but it does not in itself contribute to understanding differential participation in mathematics by men and women. In some of the earlier research done in this area, researchers have placed a great deal of importance on differences in means on suspected causal variables. If a difference existed, they reasoned, it must be contributing to the differential course taking. This is not necessarily true since correlations do not possess a transitive quality. What is important is the relationship of the suspected variable to participation, and ultimately, the interaction between the causal variable and sex in predicting participation. Because of the nature of interactions, it is possible to find no sex differences on a variable but for that variable to be highly correlated with course taking. The reverse can also be true. Overwhelming sex differences were found on variables measuring stereotyping, but a low and nonsignificant correlation with participation was found. Of course, there are variables for which there are sex differences and significant correlations with participation and these, too, are important to look at. But, what is critical in determining what is affecting participation is not sex differences in means on suspected causal variables, but the correlation of that variable with participation.

Table 9 presents statistical examples of the four possible combinations of sex differences for means and correlations with participation based on the attitudinal data from this study. Even though there is a large sex difference on the sex-role stereotyping scale, there is a near zero correlation of this scale with participation for men and women. This is intuitively seen by studying the means across the four participation groups for each sex. There is little difference in means in each of the four cells within sex, indicating no relationship of this variable with participation. Enjoyment of mathematics is an example of a variable having no sex difference in means but large and significant correlations with participation (notice the increase in means as the level of participation increases). Confidence in mathematics is an attitudinal scale which shows a sex difference and a correlation with participation. The last example, motheras a role model indicates no sex difference and a nonsignificant correlation with participation.

Also keep in mind that it is possible for some factors to be correlated with participation for one sex and not the other. Since the ultimate use of the results of this study will be to suggest areas of intervention to encourage women to take advanced mathematics, it is more important to look at the factors which correlate highly with participation for females, regardless of what the correlation is for males and whether or not the mean for females on the variable is greater than, equal to or less than the mean for males.

Correlations of Study Variables with Participation

Since the argument has just been made to look at the relationship of the variable with participation, Pearson product-moment correlations were computed for both age levels and each sex.

Knowledge of the future need and usefulness of mathematics in educational and career plans, a positive attitude toward mathematics and the encouraging influences of significant others were three categories of variables which correlated most highly with taking more mathematics. Table 10 presents the correlations of the study variables with participation for males and females in the twelfth grade and at age thirteen. In almost every case, factors which correlated for males were also correlated

TABLE 9
MEANS AND CORRELATIONS WITH PARTICIPATION FOR FOUR SAMPLE VARIABLES MEANS ARE CATEGORIZED INTO FOUR PARTICIPATION GROUPS*

Variable		Participation					Correlations	
		1	2	3	4	Row Means	M	F
Sex-Role Stereotyping	Males	61.63	63.85	64.34	65.01	63.37	.07	.11
	Females	78.27	81.51	81.80	82.26	80.44		
	Column Means	71.00	73.14	73.10	73.39			
		Participation						
		1	2	3	4	Row Means		
Enjoyment of Mathematics	Males	41.93	47.55	61.30	69.56	52.70	.47	.38
	Females	44.24	49.08	58.38	68.34	52.18		
	Column Means	43.24	48.36	59.84	68.97			
		Participation						
		1	2	3	4	Row Means		
Confidence in Mathematics	Males	53.07	58.39	68.13	78.63	62.64	.47	.42
	Females	46.27	53.06	61.44	74.82	55.78		
	Column Means	49.25	55.59	64.78	76.79			
		Participation						
		1	2	3	4	Row Means		
Mother As a Role Model	Males	67.24	52.71	60.67	61.19	63.73	-.12	-.03
	Females	66.07	64.39	67.28	63.56	65.26		
	Column Means	66.58	63.59	63.95	62.35			

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*Participation categories are defined as:

Participation 1--Students completed General Mathematics, and/or Pre-Algebra and/or Algebra I, but nothing more advanced.

Participation 2--Student completed Geometry and/or Algebra II, but nothing more advanced.

Participation 3--Students completed Trigonometry and/or Probability/Statistics, but nothing more advanced.

Participation 4--Students completed Pre-calculus or Calculus.

TABLE 10

CORRELATIONS BETWEEN STUDY VARIABLES AND MATHEMATICS PARTICIPATION FOR GRADE 12 STUDENTS AND 13 YEAR OLDS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978.

	Grade 12		Age 13	
Variables	Male	Female	Male	Female
I. Sex Role Stereotyping				
A. General Sex-Role Stereotyping	.074	.110	.182**	.060
B. Mathematics as a Male Domain	.099	.188**	.179**	.095
C. Men's Attitudes Toward Successful Women	.076	.081	.141*	.084
II. Career Plans				
A. Career Aspirations	.286**	.288**	.154*	.039
B. Mathematics Preparation Required for a Job	.499**	.400**	.193**	.103
C. Job Using Mathematics	.298**	.216**	-.116	-.142*
D. Job Done by Members of Opposite Sex	-.079	.014	.031	.008
III. Mathematics and Oneself				
A. Confidence in Mathematics	.466**	.423**	.280**	.194**
B. Anxiety in Mathematics	.348**	.325**	.285**	.192**
C. Anxiety in English	.109	.096	.015	.072
D. Anxiety in School	.212**	.225**	.272**	.092
E. Enjoyment of Mathematics	.472**	.375**	.284**	.264**
F. Locus of Control	.067	.046	.059	.097
G. Mathematics and Oneself Composite	.466**	.392**	.326**	.246**
IV. Usefulness of Mathematics	.341**	.301**	.378**	.256**
V. Academic Plans				
A. Educational Aspirations	.475**	.452**	.267**	.167**
VI. Parental Influences				
A. Father as a Role Model	.161**	.116**	.168**	.096
B. Mother as a Role Model	-.124*	-.032	.153*	.117
C. Father's Encouragement in Mathematics	.304**	.320**	.252**	.132
D. Mother's Encouragement in Mathematics	.340**	.305**	.276**	.177**
E. Father's Stereotyping of Mathematics	.050	.105	-.087	-.022
F. Mother's Stereotyping of Mathematics	.029	.100	-.083	-.065
G. Father's Educational Expectations	.466**	.386**	.207**	.104
H. Mother's Educational Expectations	.451**	.361**	.240**	.095

TABLE 10 (Contd.)

Variables	Grade 12 Male	Grade 12 Female	Age 13 Male	Age 13 Female
VII. Influences of Significant Others				
A. Peer Influence	.209**	.207**	.243**	.137*
B. Boys Stereotyping of Mathematics	-.121	.028	-.063	-.001
C. Girls Stereotyping of Mathematics	-.004	.085	-.057	-.037
D. Counselor Encouragement	.279**	.238**	.118	.240**
E. Teacher Encouragement	.414**	.433**	.243**	.161*
F. Teacher Stereotyping of Mathematics	.102	.104	.054	.024
G. Teacher Differential Treatment	.196**	.089	.149*	.059
H. Brother as Role Model	.077	.147*	.025	-.021
I. Sister as Role Model	.114	.099	.071	.010
VIII. School Experience				
A. Grades in Mathematics	.453**	.440**	.223**	.246**
B. Taking Algebra in 8th Grade	.344**	.256**	.002	.084
IX. Achievement				
A. Computation	.451**	.440**	.232**	.112
B. Algebra	.610**	.648**	.154*	.102
C. Problem Solving	.397**	.447**	.205**	.091
D. Spatial Visualization	.217**	.306**	.099	.086
E. Achievement Composite	.560**	.597**	.263**	.120
X. Background Variables				
A. Fathers Education	.258**	.329**	-.003	-.049
B. Mothers Education	.167**	.237**	.032	-.016
C. Socioeconomic Status	.122	.181**	.136	.005
D. Father's Occupation	.149*	.257**	-.015	.016
E. Mother's Occupation	.153*	.136*	.023	.087

*$p < .01$
**$p < .001$

for females. Few variables correlated differently for the two groups.

Career and educational plans were positively related to mathematics participation. The chosen career, the student's perception of the necessity of using mathematics and the amount of mathematics required for the job were all highly correlated with course taking. It is possible that the more mathematics a student perceived as being necessary for the intended career, the more likely it was that the student would take more mathematics. The reverse could also be true. That is, that students who took a lot of mathematics realized that what they were learning in class would be useful to them in their chosen career. The more general scale of "usefulness of mathematics to the individual" substantiates these results by also being highly correlated with participation.

Students' educational aspirations were also significantly related to taking high school mathematics. Those students who planned to continue their education through college and graduate school were more likely to have taken more advanced mathematics than those students who had lower academic aspirations.

Positive feelings towards mathematics and one's ability in mathematics were a second category of variables which showed a strong positive relationship with mathematics course taking. A positive attitude toward mathematics, indicated by confidence in mathematics, low anxiety and enjoyment of mathematics were highly correlated with participation. Students who liked mathematics and felt they were good in it, tended to take more mathematics while in high school than students with poorer attitudes.

The variables of parental, teacher, peer and counselor encouragement were a third category of variables which affected taking mathematics. Fathers as role models (but not mothers) and the active encouragement of both mothers and fathers were significantly correlated with participation for both males and females. Another form of parental encouragement was parents having high academic expectations for their children. Those students, especially males, whose parents had high academic expectations for them, took more mathematics.

Teachers were another group of "significant others" who seemed to have a positive effect on course taking by encouraging students. Teachers who were perceived as being interested in the students' progress in mathematics, who actively encouraged students to take more mathematics, and who made students feel they had the ability to go on in mathematics seemed to make a significant difference in student participation. Students who perceived their teachers as encouraging tended to take more mathematics.

Teacher differential treatment was one of the few variables for high school seniors which was significantly correlated with course taking for males, but not for females. Males who perceived mathematics teachers as treating the males the same as the females (i.e., no differential treatment) took more mathematics.

Approval, support and encouragement of peers (friends or classmates) may contribute to mathematics participation. Although not as highly correlated as other variables, peer influence did have a low but significant correlation with taking high school mathematics.

For women, having an older brother who was good in mathematics was related to taking more mathematics. This was not true for males or for either males or females having an older sister who was good in mathematics. This is not an unexpected result in that males have traditionally taken more mathematics so it would be much more likely to have an older brother, rather than an older sister who is good in mathematics. Presumably, the brother is acting as a role model and the younger sister is following in his footsteps.

Correlations of participation with achievement proved to be some of the highest correlations found in this study. This is certainly not an unexpected result, especially when the correlation with algebra is examined. This is the one subtest which was most course dependent. That is, a student would have had to have a course in algebra to do well on this subtest. This idea is substantiated by algebra having the highest correlation with participation of all the achievement subtests. In general, high correlations of achievement subtests with participation indicated that taking more mathematics had a positive effect on achievement.

Numerous background variables were related to mathematics participation for both males and females. A student's typical letter grade in mathematics was highly correlated with participation, as was taking Algebra I in the eighth grade. This latter variable is probably a surrogate for other factors, e.g., high achievement in mathematics in the elementary school, size of the school and a well-developed mathematics program.

Socioeconomic status was correlated with participation for females but not for males. Components of SES, parents' education and occupation, were significantly correlated with course taking for both sexes.

In addition to presenting results of variables which were correlated with participation, it is important to point out which of the "suspected causal variables" were not. The stereotyping of sex roles, mathematics and women, was not correlated with participation with the exception of mathematics as a male domain. That is, mathematics was just as appropriate for women to take as it was for men. But, teacher, peer and parent stereotyping of mathematics as more for males then females had little effect on participation for either sex.

The basic categories of variables which correlated with participation for the high school seniors were similar, although not identical for 13-year-olds. The participation variable for 13-year-olds was based on the item which asked them how much mathematics they intended to take while in high school. As mentioned in an earlier section, this was not as valid a measure of participation as the self-report measure used for the twelfth grade students. For this reason, less emphasis is placed on small differences, either between the age groups or between males and females in the following discussion. Instead, trends or patterns of correlations will be discussed and more emphasis will be placed on correlations with achievement.

Educational aspirations, a positive feeling toward mathematics and the influence of parents, peers and teachers were also related to participation for 13-year-olds as they were for the high school seniors. Obviously, 13-year-olds are not as decided about their future career and lack the knowledge of the amount of mathematics needed for a career, thus, the lack of significant correlations with these variables. But, they do seem to have a general notion of the potential usefulness of mathematics in later life and in their future educational goals.

Thirteen-year-old males seemed to be influenced more by their fathers than their mothers; 13-year-old females were influenced more by their mothers. Parents as role models and parental encouragement were related to intended mathematics participation for males. The only significant parental influence for females related to intended participation was mothers' encouragement. Interestingly, fathers' and mothers' educational expectations were correlated only for males and not females, even though females perceived their parents as having higher educational expectations for them than did 13-year-old males.

As was found for twelfth grade students, peer influence and teacher encouragement were related to intended participation for 13-year-olds.

Fewer background variables were correlated with participation, partly because of students' lack of knowledge of these variables. Socioeconomic status and parents' occupation and education were not correlated for 13-year-olds as they were for seniors, probably because 13-year-olds were unsure and not as accurate in reporting their parents' education and occupation.

Grades in mathematics were related to intended course taking for both sexes, but achievement in mathematics as measured by the subtests were correlated for males but not females.

Summarizing the information gained from studying the correlational analyses indicates that many of the variables may be "operating" in the same way for both ages and both sexes. The variables correlated with participation are those related to career and future educational aspirations, usefulness, liking mathematics and being good in it and the active approval and encouragement of taking more mathematics by parents, teachers and to some degree, peers.

Correlations of Study Variables with Achievement

Since participation is a likely predictor of achievement, it is not surprising that many of the variables which correlated with participation also correlate with achievement. Career plans, mathematics required for the chosen career, liking of mathematics, usefulness of mathematics, parental encouragement, parental educational expectations, peer and teacher influence and socioeconomic status were significantly correlated with achievement for the grade 12 sample. Mathematics as a male domain is correlated with achievement for both males and females in grade 12; absence of the stereotyping of women successful in mathematics was related to achievement only for women.

TABLE 11

CORRELATIONS BETWEEN STUDY VARIABLES AND MATHEMATICS ACHIEVEMENT FOR GRADE 12 STUDENTS AND 13 YEAR OLDS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978.

	Grade 12		Age 13	
Variables	Male	Female	Male	Female
I. Sex Role Stereotyping				
A. General Sex-Role Stereotyping	.068	.075	.198**	.329**
B. Mathematics as a Male Domain	.209**	.313**	.267**	.451**
C. Men's Attitudes Toward Successful Women	.115	.137*	.176**	.318**
II. Career Plans				
A. Career Aspirations	.298**	.194**	.168*	.186*
B. Mathematics Preparation Required for a Job	.405**	.323**	.049	-.056
C. Job Using Mathematics	.291**	.174**	-.103	-.034
D. Job Done by Members of Opposite Sex	-.095	-.122*	.094	-.057
III. Mathematics and Oneself				
A. Confidence in Mathematics	.479**	.424**	.360**	.338**
B. Anxiety in Mathematics	.354**	.321**	.313**	.270**
C. Anxiety in English	.102	.066	.078	.239**
D. Anxiety in School	.283**	.198**	.256**	.273**
E. Enjoyment of Mathematics	.396**	.361**	.181**	.080
F. Locus of Control	.104	.075	.102	.038
G. Mathematics and Oneself Composite	.447**	.387**	.321**	.260**
IV. Usefulness of Mathematics	.292**	.255**	.295**	.200**
V. Academic Plans				
A. Educational Aspirations	.462**	.395**	.237**	.238**
VI. Parental Influences				
A. Father as a Role Model	.183**	.099	.161*	.157*
B. Mother as a Role Model	-.104	-.041	.026	-.054
C. Fathers Encouragement in Mathematics	.316**	.320**	.130	.095
D. Mothers Encouragement in Mathematics	.298**	.256**	.124	.095
E. Fathers Stereotyping of Mathematics	.066	.055	-.062	-.121
F. Mothers Stereotyping of Mathematics	.026	.074	-.083	-.132
G. Fathers Educational Expectations	.501**	.325**	.216**	.198*
H. Mothers Educational Expectations	.505**	.228**	.190*	.161*

TABLE 11 (CONT.)

Variables	Grade 12 Male	Grade 12 Female	Age 13 Male	Age 13 Female
VII. Influences of Significant Others				
A. Peer Influence	.275**	.238**	.238**	.234**
B. Boys Stereotyping of Mathematics	-.052	-.016	-.053	-.074
C. Girls Stereotyping of Mathematics	.038	.127	-.196	-.219**
D. Counselor Encouragement	.202**	.258**	.256**	.195**
E. Teacher Encouragement	.360**	.360**	.238**	.188**
F. Teacher Stereotyping of Mathematics	.100	.084	.174*	.164*
G. Teacher Differential Treatment	.225**	.183**	.225**	.297**
H. Brother as Role Model	.131*	.158*	.095	.198*
I. Sister as Role Model	.237**	.110	.130	.125
VIII. School Experience				
A. Grades in Mathematics	.447**	.480**	.386	.403**
B. Taking Algebra in 8th Grade	.160**	.216**	.309**	.373**
IX. Participation	.559**	.596**	.263**	.120
X. Background Variables				
A. Fathers Education	.282**	.318**	-.060	-.073
B. Mothers Education	.272**	286**	-.056	-.099
C. Socioeconomic Status	.167**	.258**	.150*	.186**
D. Fathers Occupation	.237**	.197**	.030	.065
E. Mothers Occupation	.156*	.091	.002	.009

*p<.01
**p<.001

Interesting differences are apparent when correlations with achievement for 13-year-olds (both male and female) are compared with those for the grade 12 population. Stereotyping seems to be a much bigger issue with the younger age group in that both males and females who tended to obtain higher achievement scores had a contemporary point of view regarding stereotyping. That is, they did not differentiate between specific sex-roles and considered mathematics a topic equally suited for women as well as men. Also, 13-year-olds who perceived their teachers as not stereotyping mathematics as more for males tended to achieve more in mathematics.

Neither the mathematics preparation required for a job or the fact that the job would require using mathematics correlated with achievement for the 13-year-olds, even though these two variables did for the seniors. The same situation occurs when looking at the correlations with achievement and mothers' and fathers' encouragement. These correlated with achievement for the seniors but not the 13-year-olds.

In summary, many of the variables which correlated with participation also correlated with achievement. Similar patterns of correlations existed across broad categories of variables for both participation and achievement, both age groups and both sexes. Stereotyping, other than not viewing mathematics as a male domain, had little relationship with participation and only a moderate relationship with achievement for 13-year-old females. Career and educational aspirations were important factors affecting participation and achievement for the older age group. A positive attitude toward mathematics persists for all students who take a lot of mathematics and do well in it. Perceived usefulness of mathematics was also related to participation and achievement. Influences of significant others were relatively consistent across sex and age for participation and achievement. Parental encouragement and educational expectations for their offspring, peer influence and teacher encouragement were also correlated with participation and achievement for nearly every group.

After examining the tables presenting the correlations of participation and achievement with attitudes, it is easily understood why so many previous studies looked at so many different variables which may have been affecting participation. When most of the variables identified in earlier studies were included in this study, many were found to be significantly related to course taking.

The next question is "which of the factors which correlated with participation (or achievement) are the best predictors of participation (or achievement)? What is the relative contribution of different variables in explaining the variation in either participation or achievement?" Chapter V discusses the strategy and technique used to develop a model of prediction to answer these questions and gain more insight into the importance of certain factors in predicting participation or achievement in mathematics.

CHAPTER V

PREDICTIVE ANALYSES

Many of the attitudinal and background variables examined in this study were found to be related to participation and achievement in mathematics. Important influences were career and educational plans, positive attitudes towards mathematics, and the encouraging influences of parents, peers, teachers and school counselors.

Placement of these relationships into an ordered causal system would be valuable for the interpretation of results. Beyond the theoretical value in explaining observed sex differences in mathematics, the practical value of such information would provide a strategy for intervention and social change.

Path analysis is one predictive technique which might be helpful. At least superficially, it would appear to allow the construction of just the kind of causal model which is needed. For example, the attitudinal and background variables could be fit into a causal network and then, using the technique of path coefficents, the model could be evaluated. Unfortunately, many models are possible, depending on the particular assumptions one is willing to make. The total number of possible models may depend more on the imagination of the model builder than on the actual empirical data at hand. Furthermore, simultaneous solutions of models with highly correlated "causes" can give misleading results about the importance or unimportance of particular causal paths. Sophisticated optimization routines may also be applied, but, unfortunately, the application occurs after the critical assumptions have been made. Generally, the only test of these many assumptions is in the overall lack of fit of the model. With the highly correlated variables found in this study, it is possible that many models could be fitted to the same set of correlations.

One alternative is to use purely predictive as opposed to causal models. Predictive models require no assumptions about directions of causality, but carry with them their own variety of explanatory problems. These models, rather than constructing a complex system which includes interrelated causal factors, predict unique variation in a single variable, say mathematics participation, from a set of intercorrelated predictor variables. No assumptions are made about possible causal connection among predictors, or between predictor and predicted variables. Since only unique covariance is considered, only a single variable will be included from a group of correlated predictors. Often the particular variable, chosen because of its high partial correlation with the dependent variable, is not helpful in providing an intuitive understanding of an underlying process.

Wherever possible, the best strategy in applying causal models is to pick relatively uncorrelated predictor variables. This may be achieved through data reduction, e.g., by constructing hierarchical factors or scales. The advantage of doing this is that multiple regression techniques can be used to identify broadly defined, relatively independent classes or dimensions of variables which are related to the dependent variable. Although the classes so identified may be either causes or effects, these dimensions may at least be used as guidelines in selecting intervention strategies.

Factor analysis was used to reduce the study variables to a smaller set of relatively independent factors. Correlations among the original scales tended to be small to moderate but very diffuse, indicating substantial conceptual overlap. An attempt was made to create more independent scales by forcing an orthogonal structure onto the correlations among the items which made up the scales. All items were combined, and the matrix of intercorrelations was subjected to a principal components analysis. Communalities of one were used, and the principal components matrix was rotated to a varimax criterion. Items which were poorly defined, either by having loadings across two or more factors, or having loadings which were consistently low, were dropped. The reduced set of items was retained and refactored. This resulted in the set of ten factors or scales listed in Appendix D. The primary difference from the earlier scales is that the scales comprising "Mathematics and Oneself" collapsed into a single factor. Unfortunately when these factors were scaled using a weight of one for items with loadings of .4 or greater and deleting the remaining items, a fairly diffuse pattern of correlations still remained.

An attempt to get around this problem of diffuse correlations was made for the regression analyses. Variables were sorted into categories which had some _a priori_ meaning. First, they were classified as to whether or not they were intervenable through conventional means. "Non-intervenable" variables included school enrollment, availability of advanced mathematics courses (for grade 12) and socioeconomic status. The remainder of the scales were categorized as either representing "self" (student) or "other" characteristics. These "others" included parents, teachers and school counselors. These individuals are important in that they are the individuals who will most likely become involved in any intervention strategy. The beliefs and attitudes of the students themselves are somewhat problematic in that it is in most cases difficult to find any empirical justification for picking one as cause and another as effect. Therefore, it would be largely guesswork to predict what change would be brought about in achievement or participation after a concerted effort was made to change attitudes.

On the other hand, if changes in attitudes tend to accompany change in whatever underlying factors affect achievement and participation, then the attitudes may serve as a barometer or indicator of changes in a process which is somewhat remote and inaccessible.

Separate predictive models were devised for the "self" and "other" variables. The models involve few assumptions and all assumptions appear to be conservative. First, "self" and "other" variables were considered separately as discussed above. Although the pattern of correlations spread across this distinction, the separation makes intuitive sense and, moreover, it makes practical sense in terms of intervention strategies. A second assumption was that nonintervenable variables were considered primary whenever achievement and participation were predicted by confounded variation of intervenable and nonintervenable variables. The predictive models are hierarchical designs which identify proportions of residual variance in achievement and participation which are tied to variance in either "self" or "other" variables.

The correlations among the predictor variables and criterion variables were analyzed by way of these hierarchical regression models. Nonintervenable variables were entered simultaneously in the first step. The remainder of the variables were then entered in a stepwise fashion. In each step, the variable which was included was the one with the highest partial correlation with the criterion variable. Although the method established an _a posteriori_ sequence based upon the unique residual covariance in each step, it is recommended that the order not be taken too literally because of the multicolinearity described earlier. Rather, the increase in predicted variance over that which is possible from nonintervenables is the focus of this analysis, particularly at the level at which additional variables no longer contribute significantly to the overall predictive model.

Critical levels for contributing to the overall regression model were determined as follows: Sample sizes varied somewhat across the different predictor variables within age and sex categories, but most fell within a lower boundary of 400. This bound was adjusted for sampling bias. For this sample size, the cutoff point for a significant contribution to the multiple R, i.e., for the R^2 change to be significant at the .05 level, corresponded roughly to a one percent increment in the R^2. The overall models were highly significant in every case.

The results of the regression analyses are presented in Tables 12 through 19. Regression analyses were performed separately for participation and achievement and separately for sex and age. Nonintervenable variables (school characteristics and SES) were entered into the regression analysis first, making it possible to determine the increase in R^2, which could be attributed to the student or significant others. Again, when interpreting these results, it should be remembered that importance should not be placed on the order of the variables. Even after factor analyses, it was impossible to reduce the correlations among the scales. This means that this variable may also be a surrogate for another variable correlated with it. What is important is to make note of the variables which are present, expecially those which are accessible to intervention.

Table 12 presents a predictive model for mathematics achievement for twelfth grade males. Parental encouragement, including direct encouragement,

TABLE 12

A PREDICTIVE MODEL FOR MATHEMATICS ACHIEVEMENT UTILIZING ATTITUDES OR PARENT AND TEACHER CHARACTERISTICS OF GRADE 12 MALES

Variable	Simple Correlation with Achievement	Squared Multiple Correlation	Increase in R^2 Due to Addition of Intervenable Variables
"Non-Intervenable" Variables			
School Enrollment	-.02		
Socioeconomic Status	.17		
Number of Mathematics Courses Offered	.12		
Most Advanced Mathematics Course Offered	.21	.06	.00
	Prediction Model 1: Characteristics of Others		
Attitudinal Variables Adding At Least 1% to Predicted Variance			
Mothers Educational Expectations	.50		
Teacher Encouragement	.28		
Mother As a Role Model	-.10		
Parental Encouragment	.31	.35	.28
Related Variables Adding Less than 1% to Predicted Variance			
Fathers Educational Expectations	.50		
Teacher Differential Treatment	.21		
Counselor Encouragement	.20		
Father as a Role Model	.18		
Teacher Stereotyping	.19	.37	.30

(This Table is continued on the next page.)

TABLE 12 (CONT.)

Variable	Simple Correlation with Achievement	Squared Multiple Correlation	Increase in R^2 Due to Addition of Intervenable Variables
	Predictive Model 2: Characterisitcs of Self		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Attitudes Toward Mathematics	.45		
Educational Aspirations	.46		
Mathematics Preparation Required for Job	.40		
Career Aspirations	.30	.38	.31
Related Variables Adding Less Than 1% to Predicted Variance			
Usefulness of Mathematics	.24		
Stereotyping of Women	.18		
Locus of Control	.10		
School Anxiety	.16	.39	.32

the passive influence of mother as a role model and the mother's educational expectations accounted for an additional 28 percent of the variance when significant others were used to predict achievement. In a second model where student characteristics are used, attitudes towards mathematics, educational and career aspirations and the perceived amount of mathematics needed for the job accounted for a 31 percent increase in total variance after the nonintervenable variables were accounted for.

Similar results were found for females in grade 12. These results are shown in Table 13. In terms of significant others, influences of parents and teachers seemed to be the best predictors of achievement. Teacher encouragement, father's educational expectations, parental encouragement, mother as a role model and counselor encouragement accounted for almost a 20 percent increase in explained variance. The second model predicting mathematics achievement for twelfth grade females considered student characteristics. A 26 percent increase in R^2 was attributable to attitudes towards mathematics, educational aspirations and the amount of mathematics preparation needed for the job.

Considerably less variance could be determined based on the characteristics of others or self for 13-year-old males as shown in Table 14. Only 10 percent of the variance could be predicted by teacher differential treatment, father's educational expectations and counselor encouragement. Characteristics of the student predicted achievement better for 13-year-old males. Attitudes towards mathematics, the (lack of) stereotyping of women, educational aspirations and locus of control (the student perceiving himself as solely responsible for how well he does in mathematics) predicted an additional 16 percent of the variance.

Results on achievement regression analyses for 13-year-old females were similar to those for males and are presented in Table 15. Again, teacher differential treatment, father's educational expectations and counselor encouragement were the variables related to significant others which best predicted achievement. Stereotyping of women, attitudes towards mathematics, school anxiety and educational aspirations were the student characteristics which best predicted achievement.

Tables 16 through 19 present the results of the regression analyses for mathematics participation. As was done for the analyses predicting

TABLE 13

A PREDICTIVE MODEL FOR MATHEMATICS ACHIEVEMENT UTILIZING ATTITUDES OR PARENT AND TEACHER CHARACTERISTICS FOR GRADE 12 FEMALES

Variable	Simple Correlation with Achievement	Squared Multiple Correlation	Increase in R^2 Due to Addition of Intervenable Variables
"Non-Intervenable" Variables			
School Enrollment	-.04		
Number of Mathematics Courses Offered	.09		
Socioeconomic Status	.26		
Most Advanced Mathematics Course Offered	.25	.12	.00
	Predictive Model 1: Characteristics of Others		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Teacher Encouragement	.31		
Fathers Educational Expectations	.32		
Counselor Encouragement	.26		
Parental Encouragement	.30		
Mother As a Role Model	-.08	.31	.19
Related Variables Adding Less Than 1% to Predicted Variance			
Mothers Educational Expectations	.23		
Father as a Role Model	.12		
Teacher Differential Treatment	.24		
Teacher Stereotyping	.15	.32	.20

(This Table is continued on the next page.)

TABLE 13 (CONT.)

Variable	Simple Correlation with Achievement	Squared Multiple Correlation	Increase in R^2 Due to Addition of Intervenable Variables
	Predictive Model 2: Characteristics of Self		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Attitudes Towards Mathematics	.39		
Educational Aspirations	.40		
Mathematics Preparation Required for Job	.32	.38	.26
Related Variables Adding Less Than 1% to Predicted Variance			
Stereotyping of Women	.24		
Usefulness of Mathematics	.23		
Career Aspirations	.19		
School Anxiety	.11		
Locus of Control	.08	.39	.27

TABLE 14

A PREDICTIVE MODEL FOR MATHEMATICS ACHIEVEMENT UTILIZING ATTITUDES OR PARENT AND TEACHER CHARACTERISITICS OF AGE 13 MALES

Variable	Simple Correlations with Achievement	Squared Multiple Correlation	Increase in R^2 Due to Addition of Intervenable Variables
"Non-Intervenable" Variables			
School Enrollment	-.05		
Socioeconomic Status	.15	.03	.00
	Predictive Model 1: Characteristics of Others		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Teacher Differential Treatment	.22		
Fathers Educational Expectations	.22		
Counselor Encouragement	.21	.13	.10
Related Variables Adding Less Than 1% to Predicted Variance			
Parental Encouragement	.04		
Father As a Role Model	.16		
Teacher Encouragement	.19		
Teacher Stereotyping	.18		
Mothers Educational Expectations	.19		
Mother as a Role Model	.03	.16	.13

This Table is continued on the next page.

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TABLE 14 (CONT.)

Variable	Simple Correlation with Achievement	Squared Multiple Correlation	Increase in R^2 Due to Addition of Intervenable Variables
	Predictive Model 2: Characteristics of Self		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Attitudes Toward Mathematics	.35		
Stereotyping of Women	.25		
Educational Aspirations	.24		
Locus of Control	.10	.19	.16
Related Variables Adding Less Than 1% to Predicted Variance			
Career Aspirations	.17		
Mathematics Preparation Required for Job	.05		
Usefulness of Mathematics	.24		
School Anxiety	.13	.21	.18

TABLE 15

A PREDICTIVE MODEL FOR MATHEMATICS ACHIEVEMENT UTILIZING ATTITUDES OR PARENT AND TEACHER CHARACTERISTICS OF AGE 13 FEMALES

Variable	Simple Correlation with Achievement	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
"Non-Intervenable" Variables			
School Enrollment	-.02		
Socioeconomic Status	.19	.03	.00
	Predictive Model 1: Characteristics of Others		
Attitudinal Variables Adding At Least 1% to Predicted Variance			
Teacher Differential Treatment	.33		
Counselor Encouragement	.31		
Fathers Educational Expectations	.20		
Mother as a Role Model	-.05	.23	.20
Related Variables Adding Less Than 1% to Predicted Variance			
Parental Encouragement	.09		
Teacher Stereotyping	.25		
Mothers Educational Expectations	.16		
Teacher Encouragement	.14		
Father as a Role Model	.16	.25	.22

(This Table is continued on the next page.)

TABLE 15 (CONT.)

Variable	Simple Correlation With Achievement	Square Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
	Predictive Model 2: Characteristics of Self		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Stereotyping of Women	.43		
Attitudes Towards Mathematics	.30		
School Anxiety	.28		
Educational Aspirations	.24	.26	.23
Related Variables Adding Less Than 1% to Predicted Variance			
Mathematics Preparation Required for Job	-.05		
Career Aspirations	.18		
Usefulness of Mathematics	.18		
Locus of Control	.04	.27	.24

achievement, nonintervenable variables of school characteristics were entered first and taken into account in the subsequent analyses.

Predictive models for twelfth grade males are presented in Table 16. Father's educational expectations, counselor encouragement, mother as a role model and her educational expectations and parental encouragement accounted for a 28 percent increase in R^2. Attitudes towards mathematics accounted for an additional 36 percent of the variance when only "self" variables were included in the analysis.

When the predictive models for achievement and participation are compared for males in grade 12, the results are remarkably similar. The identified variables for both predictive models were identical but for achievement, teacher encouragement added to the predictive model of "others" and career aspirations added to the predictive model of "self."

Results for regression analyses of participation for twelfth grade females appear in Table 17. The variables related to significant others which were the best predictors of participation were father's educational expectations, teacher encouragement and (lack of) stereotyping. This variable accounted for an increase of 21 percent of the variance. The characteristics of self which were most predictive were educational aspirations, attitudes towards mathematics and the mathematics preparation required for a job. These accounted for 30 percent of the variance in this model after the variance attributed to the nonintervenable variables was accounted for.

Differences do exist for "other" variables which predict participation when grade 12 males and females are compared. Father's educational expectations predicted participation for both groups, but teacher variables played a more important role in predicting female participation. Influences of parents and counselors seemed to be better predictors for males.

The lack of validity of the participation measure for 13-year-olds made it very difficult to accurately predict intended participation. This is reflected in the low percentages of variance explained by either predictive model for both sexes.

Table 18 presents the results of the predictive models for intended mathematics participation for 13-year-old males. The nonintervenable

TABLE 16

A PREDICTIVE MODEL FOR MATHEMATICS PARTICIPATION UTILIZING ATTITUDES OR PARENTAL AND TEACHER CHARACTERISTICS OF GRADE 12 MALES

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
"Non-Intervenable" Variables			
School Enrollment	-.06		
Socioeconomic Status	.12		
Number of Mathematics Courses Offered	.09		
Most Advanced Mathematics Course Offered	.08	.03	.00
	Predictive Model 1: Characteristics of Others		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Fathers Educational Expectations	.47		
Counselor Encouragement	.28		
Mother as a Role Model	-.12		
Parental Encouragement	.32		
Mothers Educational Expectations	.46	.31	.28
Related Variables Adding Less than 1% to Predicted Variance			
Teacher Encouragement	.28		
Teacher Stereotyping	.11		
Teacher Differential Treatment	.15		
Father as a Role Model	.14	.32	.29

(This Table is continued on the next page.)

TABLE 16 (CONT.)

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
	Predictive Model 2: Characteristics of Self		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Mathematics Preparation Required for a job	.50		
Educational Aspirations	.48		
Attitudes toward Mathematics	.44	.39	.36
Attitudinal Variables Adding Less than 1% to Predicted Variance			
Career Aspirations	.29		
Usefulness of Mathematics	.30		
School Anxiety	.15		
Stereotyping of Women	.12		
Locus of Control	.07	.40	.37

TABLE 17

A PREDICTIVE MODEL FOR MATHEMATICS PARTICIPATION UTILIZING ATTITUDES OR PARENTAL AND TEACHER CHARACTERISTICS OF GRADE 12 FEMALES

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
"Non-Intervenable" Variables			
School Enrollment	.08		
Number of Mathematics Courses Offered	-.02		
Socioeconomic Status	.18		
Most Advanced Mathematics Course Offered	.16	.07	.00
	Predictive Model 1: Characteristics of Others		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Fathers Educational Expectations	.39		
Teacher Encouragement	.36		
Teacher Stereotyping	.04	.28	.21
Related Variables Adding Less Than 1% Predicted Variance			
Parental Encouragement	.32		
Mother As a Role Model	-.04		
Counselor Encouragement	.24		
Mothers Educational Expectations	.36		
Teacher Differential Treatment	.10		
Father as a Role Model	.10	.31	.24

(This Table is continued on the next page.)

TABLE 17 (CONT.)

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
	Predictive Model 2: Characteristics of Self		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Educational Aspirations	.45		
Attitudes Towards Mathematics	.38		
Mathematics Preparation Required for Job	.40	.37	.30
Related Variables Adding Less Than 1% to Predicted Variance			
Career Aspirations	.29		
Stereotyping of Women	.18		
School Anxiety	.14		
Locus of Control	.04		
Usefulness of Mathematics	.26	.37	.31

TABLE 18

A PREDICTIVE MODEL FOR MATHEMATICS PARTICIPATION UTILIZING ATTITUDES OR PARENT AND TEACHER CHARACTERISTICS OF AGE 13 MALES

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
"Non-Intervenable" Variables			
School Enrollment	.03		
Socioeconomic Status	.14	.02	.00
	Predictive Model 1: Characteristics of Others		
Attitudinal Variables Adding At Least 1% to Predicted Variance			
Mothers Educational Expectations	.24		
Parental Encouragement	.23	.10	.08
Related Variables Adding Less than 1% to Predicted Variance			
Teacher Encouragement	.19		
Counselor Encouragement	.12		
Mother as a Role Model	.16		
Teacher Differential Treatment	.12		
Father as a Role Model	.16		
Teacher Stereotyping	.13		
Fathers Educational Expectations	.21	.11	.09

(This Table is continued on the next page.)

TABLE 18 (CONT.)

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
	Predictive Model 2: Characterisitcs of Self		
Attitudinal Variables Adding At Least 1% To Predicted Variance			
Usefulness of Mathematics	.35		
Attitudes Toward Mathematics	.31		
Educational Aspirations	.27	.19	.17
Related Variables Adding Less than 1% To Predictive Variance			
Career Aspirations	.15		
Locus of Control	.06		
Stereotyping of Women	.19		
School Anxiety	.17		
Mathematics Preparation Required for Job	.19	.19	.18

TABLE 19

A PREDICTIVE MODEL FOR MATHEMATICS PARTICIPATION UTILIZING ATTITUDES OR PARENT AND TEACHER CHARACTERISTICS OF AGE 13 FEMALES

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
"Non-intervenable" Variables			
School Enrollment	-.01		
Socioeconomic Status	.01	.00	.00
	Predictive Model 1: Characterisitcs of Others		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Counselor Encouragement	.24		
Fathers Educational Expectations	.10	.07	.07
Related Variables Adding Less than 1% to Predicted Variance			
Mother as a Role Model	.09		
Teacher Differential Treatment	.01		
Parental Encouragement	.14		
Teacher Stereotyping	.02		
Father as a Role Model	.07		
Teacher Encouragement	.07	.08	.08

(This Table is continued on the next page.)

TABLE 19 (CONT.)

Variable	Simple Correlation with Participation	Squared Multiple Correlation	Increase in R^2 Due to the Addition of Intervenable Variables
	Predictive Model 2: Characteristics of Self		
Attitudinal Variables Adding at Least 1% to Predicted Variance			
Usefulness of Mathematics	.24		
Attitudes Towards Mathematics	.22		
Educational Aspirations	.17	.09	.09
Related Variables Adding Less Than 1% to Predicted Variance			
Locus of Control	.10		
Mathematics Preparation Required for job	.10		
Career Aspirations	.04		
Stereotyping of Women	.09		
School Anxiety	.10	.10	.10

variables of school enrollment and SES were accounted for in both predictive models. Mother's educational expectations and parental encouragement accounted for a small increase of 8 percent in the R^2 in the model including the influences of "others." The usefulness of mathematics, attitudes towards mathematics and educational aspirations [illegible] accounted for a 17 percent increase in common variance in the "self" predictive model.

Results for 13-year-old females appear in Table 19. Father's educational expectations and counselor encouragement were the best predictors of intended participation but accounted for a slight 7 percent increase of the explained variance. As was true for 13-year-old males, the best "self" predictors of intended participation were the perceived usefulness of mathematics, attitudes towards mathematics and educational aspirations.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to identify the factors affecting mathematics participation and to determine the relative importance of these factors. These objectives were accomplished. In addition to collecting reliable national data on participation and achievement, the analysis of these data has suggested areas for possible intervention as well as suggest areas for future experimental research. In this final chapter, these results and suggestions will be summarized.

Achievement

Achievement data from this study as well as data from the second NAEP mathematics assessment suggest that 13-year-old women start their high school mathematics program with at least the same mathematical abilities as men. Thirteen-year-old women are better at computation and spatial visualization than their male counterparts. At this age, their problem-solving skills are nearly equal.

The equality in mathematical abilities changes by the time students finish high school. Males show superior scores on problem-solving measures and women have lost their advantage in computation and spatial visualization to the extent that scores on tests measuring these skills are similar for both sexes. The hypothesis that males have a superior ability in spatial visualization which accounts for their superior achievement in mathematics is refuted by the data from this study. Although males were found to be better problem solvers by the end of high school, no differences were found on a spatial ability measure.

Participation

The large sex differences found in participation in earlier studies were not found in this recent national survey. Both the NAEP data and the self-report data from this survey on course taking indicate that no sex differences in participation exist for general mathematics courses or Algebra I and Geometry. The NAEP assessment found statistically significant differences favoring males for the advanced courses of Trigonometry and Pre-Calculus/Calculus. This Women and Mathematics study found significant differences favoring males for Algebra II and Probability/Statistics, but not for the higher level courses of Trigonometry, Pre-Calculus and Calculus. But, differences found in course taking for these advanced courses always favored males.

Thirteen-year-old men and women were equally optimistic about how much mathematics they might take while in high school. In fact, where any difference in intended participation existed, women had the advantage. When this result is combined with the data indicating 13-year-old women achieve as well or better than their male counterparts at this age, it seems that they start their high school mathematics experience on equal footing with men. That is, they start high school with the same ability and willingness to take mathematics. In terms of intervention, the strategy should be to maintain these skills and attitudes throughout the high school years.

Achievement Within Participation Levels

When achievement results were analyzed within participation levels for senior men and women, some researchers might find the results unexpected. Although few differences were found within levels of participation for the lower level skills of computation and algebra, significant differences were found for nearly every level of participation on problem solving in the NAEP data, although, results from the Women and Mathematics study indicated no differences in problem-solving skills at the very highest levels of participation of Pre-Calculus and Calculus. Previous researchers suggested that sex differences in achievement would disappear once course taking was taken into account. In fact, some predicted higher scores for women considering the likelihood that the more able and persistent woman was taking advanced mathematics courses. This has turned out not to be the case, making these results difficult to explain.

Attitudes and Participation

Information gained from both the correlational analyses and regression analyses indicates certain categories of intervenable variables are related to participation and that many of these variables predict participation. Three groups of variables seemed to have the greatest effect on participation: positive attitudes towards mathematics (including enjoyment of, confidence in and low anxiety in mathematics); the perceived need for mathematics for future career and educational plans; and the positive influences of significant others, including parents, teachers, counselors and to some degree, peers.

Positive Attitudes Towards Mathematics

The revised "Attitudes Towards Mathematics" scale which was used in the regression analyses was basically a composite measure based on the enjoyment, confidence and anxiety scales used in the survey. It should be interpreted as a scale identifying positive attitudes or feelings towards mathematics. For males and females at both ages, this measure was one of the best predictors of participation when "self" variables were entered into the regression equations. Even in the correlational analyses, the scales of confidence, enjoyment and lack of anxiety had some of the highest correlations with participation.

Interpretation of these attitudes and their relationship with course taking can be looked at in two ways. First, are positive attitudes necessary before a student takes more mathematics, or second, does taking more mathematics encourage positive attitudes? Since the data from this study cannot answer this question· it would be best to assume that students with positive attitudes take more mathematics. Positive effects on course taking might result if a concerted effort was made by parents and teachers to encourage good attitudes towards mathematics. Intervention strategies might be aimed at ways of helping teachers to instill mathematical confidence in their students and increase their enjoyment of mathematics.

An attitude toward mathematics which has frequently appeared in the popular press is "math anxiety." Much has been written about women's fear of mathematics and its resultant effect of avoiding mathematics courses. Women in this study were found to be more anxious about mathematics than men and anxiety was a factor affecting participation. These results indicate that desensitization techniques and math anxiety clinics may be successful areas for future intervention. More experimental research is needed on assessing effective methods of reducing math anxiety and increasing confidence in mathematics.

Career and Educational Aspirations

A second category of variables related to course taking was career and educational aspirations and the perceived usefulness of mathematics. The amount of mathematics needed for a chosen career and the amount of education a student intended to complete were two predictors of participation for seniors when "self" variables were entered into the regression analyses. These same variables were important predictors for the 13-year-olds, with one exception. Usefulness of mathematics, compared with mathematics preparation required for a chosen career, was the better predictor of participation. This is understandable considering the general lack of knowledge 13-year-olds have regarding skills needed for careers. But, they did have the same general perception that knowing mathematics would be useful to them in later life.

An obvious area for intervention is to affect attitudes towards careers by initiating some type of career awareness program in the junior and senior high schools. Students who know they will need mathematics in their future career or to complete their education are more likely to take mathematics. Three or four years of academic mathematics in high school are required to get into the college mathematics required for many majors.

One group, the Math/Science Network in the San Francisco Bay area has pioneered intervention programs to encourage women to consider scientific careers (see Schwandt, Kreinberg and Downie, 1980 and Koltnow, 1979) Their goal has been to widen options and improve career awareness through mathematics and science education. They have introduced role models at weekend conferences and career activities in the classroom. Articulate women in nontraditional fields attend conferences for high school girls and discuss aspects of their career and the training it required. Classroom activities encourage students to consider as many career options as possible, to learn about careers related to their interest and to determine and take the necessary mathematics and science courses that these careers will require.

Teachers are not the only change agents in terms of career awareness and educational aspirations. Students' educational aspirations are likely a reflection of partents' aspirations for them. Because of this, parents might encourage their children to set their educational goals as high as is realistic and to make them realize that taking mathematics is a necessity for getting into the college of their choice as well as prepare them for most college majors. Increasingly, more college majors, especially in the social sciences, are requiring a background in mathematics.

School counselors could play an important role in making students more aware of career options and the requisite courses they need to take while in high school. Counselors need to become aware of career possibilities for women since over 90% of the women they counsel will work a significant portion of their lives. Hopefully, Title IX, which requires nonbiased counseling for women has prompted counselors to give more attention to career opportunities for women.

Significant Others

As just mentioned, parents, teachers and school counselors are in ideal positions to encourage both men and women to take more mathematics. When scales measuring the effects of significant others were entered into regression equations, parental encouragement, parental educational expectations and counselor encouragement were the best predictors of participation for twelfth grade men. For women, father's educational expectations and teacher encouragement were the best predictors of course taking.

It is the active encouragement of parents, teachers and counselors which seems to be affecting participation. The measure of parents' influence as role models, a passive influence (e.g., parents were perceived as liking mathematics and using it) did not correlate with participation. Parents don't need to be good examples regarding mathematics for their children to take mathematics in school. But, they could stress the importance of mathematics and encourage their children to take it by discussing high school course selections and future career options.

A point needs to be made regarding the effect of stereotyping of mathematics on women's participation. Although an absence of teacher stereotyping of mathematics was one of the predictors for participation of senior women, most of the stereotyping measures showed a low or insignificant correlation with participation. Stereotyping may not be one of the dominant factors affecting participation, but it does deserve some attention in terms of intervention. For senior women, the "mathematics as a male domain" scale had a low but significant correlation with participation. Women who saw mathematics as a field of study equally appropriate for women and men were more likely to take advanced mathematics courses. Areas for intervention could include programs which help women realize the appropriateness of pursuing a career in a mathematical or technical field.

Future Research

Results from this large national survey has helped identify areas for future, small-scale research studies. Of highest priority would be experimental studies which explore the problem of women's lower performance on problem-solving measures. Possible causes need to be identified and suggestions made for intervention.

Because sex differences in achievement were found within levels of mathematics participation, it might be more productive for future research studies to look more closely at achievement rather than participation. Even when women took the same amount of mathematics as men, they did not do as well on the problem-solving measure. The notion that participation predicts achievement may be too simplistic a model. Other factors are affecting achievement for women and these needed to be identified.

As mentioned earlier, some intervention programs are already underway. Strategies to promote mathematics participation vary from program to program. Evaluations of these programs, especially the long-term effects of career workshops, use of role-models and classroom activities on participation and achievement would help in identifying successful intervention techniques.

Conclusion

The factors affecting participation are both numerous and complex.

Results reported in this study indicate that the large differences in participation between men and women have diminished considerably in the past few years. It was also found that most of the factors which seem to affect participation are the same for males and females.

Because large sex differences in participation were not found, the issue of mathematics participation should not be forgotten or ignored. The importance of taking high school mathematics cannot be overemphasized. Of the 42% of all students who indicated they were in a college preparatory program, only 25% had taken the four years of high school mathematics necessary for the college mathematics they would need for many majors.

Participation in mathematics is mostly an issue of awareness. If parents, teachers and counselors understand and transmit to students the necessity of taking mathematics to keep their options open and if they have the same high expectations for women as they have for men, then a basis for equal opportunity in scientific and technical fields will exist--for men and women.

BIBLIOGRAPHY

General Reviews

Aiken, Lewis R. Jr. "Attitudes toward Mathematics," *Review of Educational Research* 1970, 40. 551-596.

Aiken, Lewis R. Jr. "Update on Attitudes and Other Affective Variables in Learning Mathematics, "*Review of Educational Research*"1976, 46, 293-311.

Aiken, Lewis R. Jr. "Some Speculations and Findings Concerning Sex Differences in Mathematical Abilities and Attitudes." In Fennema, Elizabeth (Ed.), *Mathematics Learning: What Research Says About Sex Differences*, December 1975, Columbus, Ohio: ERIC Mathematics, Science and Environmental Education Clearinghouse, 13-20.

Casserly, Patricia Lund. *An Assessment of Factors Affecting Female Participation in Advanced Placement Programs in Mathematics, Chemistry and Physics*. Report to the National Science Foundation, July 1975, 42 pp.

Ernest, John. *Mathematics and Sex*. Santa Barbara: Universtiy of California, April 1976, 30 pp.

Fennema, Elizabeth. "Mathematics Learning and the Sexes: A Review." *Journal for Research in Mathematics Education*, 1974a, 126-139.

Fennema, Elizabeth. "Sex Differences in Mathematics Learning: Why???" *The Elementary School Journal*, 1974b, *75*, 183-190.

Fennema, Elizabeth and Sherman, Julia. "Sex Related Differences in Mathematics Achievement, Spatial Visualization and Affective Factors." *American Educational Research Journal* 1977, *14*, 51-71.

Haven, Elizabeth W. "Factors Associated with the Selection of Advanced Academic Mathematics Courses by Girls in High School" (Doctoral dissertation, University of Pennsylvania, 1971). *Dissertation Abstracts International*, 1971, *32*, 1747A. (University Microfilms No. 71-26027).

Hilton, Thomas L. and Berglund, Gosta W. "Sex Differences in Mathematics Achievement: A Longitudinal Study." *Journal of Educational Research*, 1974, *67*, 231-237.

Husen, T. (Ed.) *International Study of Achievement in Mathematics*, John Wiley and Sons, New York, 1976 (2 volumes).

Maccoby, Eleanor E. and Jacklin, Carol N. "The Psychology of Sex Differences." Stanford, California: *The Stanford Universtiy Press*, 1974, 634 pp.

Romberg, T.A. and Wilson, J.W. *The Development of Tests*, NLSMA Reports, No. 7, School Mathematics Study Group, Stanford, California, 1969.

Sherman, Julia and Fennema, Elizabeth. "The Study of Mathematics by High School Girls and Boys: Related Variables." *American Educational Research Journal* 1977, 14 159-168.

General Attitude

Adams, Sam and Von Brock, Robert C. "The Development of the A-V Scale of Attitudes toward Mathematics," *Journal of Educational Measurement* 1967, 4, 247-248.

Aiken, Lewis R. Jr. "Nonintellective Variables and Mathematics Achievement: Directions for Research," *Journal of School Psychology* 1970, 8, (1), 28-36.

*Aiken, Lewis R. Jr. "Personality Correlates of Attitude toward Mathematics," *Journal of Educational Research* 1963, 56, (9), 476-480.

Aiken, Lewis R. Jr. "Research on Attitudes toward Mathematics," *Arithmetic Teacher* 1972, 229-234.

Aiken, Lewis R. Jr. and Dreger, Ralph Mason. "The Effect of Attitudes on Performance in Mathematics, "*Journal of Educational Psychology* 1961, 52, (1), 19-24.

*Aiken, Lewis R. Jr. "Two Scales of Attitude Toward Mathematics," *Journal of Research in Mathematics Education* 5, (2), 1974.

Anttonen, Ralph G. "A Longitudinal Study in Mathematics Attitude," *Journal of Educational Research* 1969, 62, (10), 467-471.

*Callahan, Walter J. "Adolescent Attitudes toward Mathematics," *Mathematics Teacher* 1971, 64, 751-755.

*Dutton, Wilbur H. "Another Look at Attitudes of Junior High School Pupils toward Arithmetic," *Elementary School Journal* 1968 B, 68, 265-268.

Dutton, Wilbur H. "Attitudes toward Arithmetic," *Elementary School Journal* 1951, 52, 86-89.

Dutton, Wilbur H. "Measuring Attitudes toward Arithmetic," *Elementary School Journal* 1954, 55, 26-29.

*Dutton, Wilbur H. "Prospective Elementary School Teachers' Understanding of Arithmetical Concepts," *Journal of Educational Research* 1965, 58, (8), 363.

Dutton, Wilbur H. "The Measurement of Attitudes toward Arithmetic with a Likert-Type Test," *Elementary School Journal* 1968 A, 68, 259-268.

*Asterisks indicate an instrument is included in the reference.

Farley, Sister Mary de Chantal. "A Study of the Mathematical Interests, Attitudes and Achievement of Tenth and Eleventh Grade Students" (Doctoral dissertation, Universtiy of Michigan, 1968). Dissertation Abstracts International, 1969, 29, 3039A. (University Microfilms No. 69-2312).

*Fellows, Martha M. "A Mathematics Attitudinal Device," Arithmetic Teacher 1973, 20, 222-223.

*Hoyt, C.J. and MacEachern, D.G. "An Investigation of the Interrelationships Among Attitudes Toward Arithmetic, Various Aspects of Achievement in Arithmetic, and Mental Ability of Junior High School Pupils" (unpublished manuscript), University of Minnesota, 1958.

*Johnson, Donovan. "Teaching Attitudes in Mathematics," School Science and Mathematics 1957, 57, 118-119.

*Malone, W.H. and Freel, E.L. Journal of Educational Research 1953-1954, 47, 602-605.

Mitzel, Harold E. "A Commonwealth Consortium to Develop, Implement, and Evaluate a Pilot Program of Computer-Assisted Instruction for Urban High Schools," 1971, ERIC ED 059 604.

Poffenberger, Thomas M. and Norton, Donald A. "Factors Determining Attitudes Toward Arithmetic and Mathematics." The Arithmetic Teacher, April 1956, 113-116.

Poffenberger, Thomas M. and Norton, Donald A. "Factors in the Formation of Attitudes Toward Mathematics." Journal of Educational Research, 1959, 52, (5), 171-176.

Shapiro, Esther Winkler. "Attitudes Toward Arithmetic Among Public School Children in the Intermediate Grades" (Doctoral Dissertation, University of Denver, 1961). Dissertation Abstracts International, 1962, 22, 3927A. (University Microfilms No. 62-1222).

*Stright, Virginia M. "A Study of the Attitudes toward Arithmetic of Students and Teachers in the Third, Fourth, and Sixth Grades," Arithmetic Teacher 1960, 7, (6).

Sex Role Stereotype

Bem, Sandra L, and Lenney, Ellen. "Sex Typing and the Avoidance of Cross-Sex Behavior," Journal of Personality 1976, 33, (1), 48-54.

Elton, Charles F. and Rose, Harriett A. "Traditional Sex Attitudes and Discrepant Ability Measures in College Women." Journal of Counseling Psychology, 1967, 14, (6), 538-543.

Fernberger, Samuel W. "Persistence of Stereotypes Concerning Sex Differences," Journal of Abnormal and Social Psychology 1948, 43, 97-101.

Gaskell, Jane. "Explaining the Aspirations of Working Class Girls," 1975, ERIC ED 113 624.

Iglitzen, Lynne B. "A Child's Eye View of Sex Roles." *Today's Education*, 1972, 23-25 (shorter version of a talk at the American Political Science Association in Wahington, D.C., 1972).

Iglitzen, Lynne B. "A Child's Eye View of Sex Roles." In *Sex Role Stereotyping in the Schools*. Washington, D.C.: National Education Association, 1973. 23-30.

Kitay, Philip M. "A Comparison of the Sexes in Their Attitudes and Beliefs about Women: A Study of Prestige Groups," *Sociometry* 1940, *34*, 399-407.

Komarovsky, Mirra. "Cultural Contradictions and Sex Roles," *American Journal of Sociology* 1946, *52*, (3), 184-189.

Landy, F.; Rosenberg, B.G. and Sutton-Smith, B. "The Effect of Limited Father Absence on Cognitive Development." *Child Development*, 1969, *40*, 941-944.

Levy, Betty. "Sex Role Socialization in Schools." *Today's Education*. December 1972, 27-29. Also in: *Sex Role Stereotyping in the Schools*, Washington, D.C.: National Education Association, 1973, 1-7.

*Michaels, J.W. "Rationale and Design for Reducing Sex Differences in Occupational and Educational Attainment by Stereotyping Across--Sex Peer Influences." Report No. 196, ED 114 754, 1975.

*Osmond, Marie Withers and Martin, Patricia. "Sex and Sexism: A Comparison of Male and Femal Sex-Role Attitudes," *Journal of Marriage and the Family* 1975, *37*, 744-758.

*Parelius, Ann. P. "Emerging Sex-Role Attitudes, Expectations, and Strains Among College Women," *Journal of Marriage and the Family* 1975, *37*, 146-152.

*Rosenkrantz, Paul et al. "Sex-Role Stereotypes and Self-Concepts in College Students," *Journal of Consulting and Clinical Psychology* 1968, *32*, (3), 287-295.

*Spence, Janet T.; Helmreich, Robert and Stapp, Joy. "Ratings of Self and Peers on Sex Role Attributes and Their Relation to Self-Esteem and Conceptions of Masculinity and Femininity," *Journal of Personality and Social Psychology* 1975, *32*,(1), 29-39.

Stacey, Judith; Bereaud, Susan and Daniels, Joan (Eds.) *And Jill Came Tumbling After: Sexism in American Education*, 1974, New York: Dell Publishing Co., Inc., 461 pp.

Stein, A.H. and Smithells, J. "Age and Sex Differences in Children's Sex Role Standards about Achievement." *Developmental Psychology*, 1969, *1*, 252-259.

Stein, Aletha H.; Pohly, Sheila and Mueller, Edward. "The Influence of Masculine, Feminine, and Neutral Tasks on Children's Achievement Behavior, Expectancies of Success, and Attainment Values," Child Development 1971, 42, 195-207.

*Stokes, C. Shannon and Willits, Fern K. "A Preliminary Analysis of Factors Related to Sex-Role Ideology among Rural-Origin Females," 1974, ERIC ED 093 565.

Vroegh, Karen. "Young Children's Sex Role and Knowledge of Sex Stereotypes," 1975, ERIC ED 118 255.

Career

General Attitude Toward Work

*Crites, J.O. "Measurement of Vocational Maturity in Adolescence," Psychological Monographs 1965, 75, (2), #595, 35-36.

*Occupational Education Program. "Battery #1 Image of the World of Work," Rocky Mountain Educational Laboratory, Inc.

Thomas, Hollie B. "A Measure of Career Development Responsibility," 1974, ERIC ED 093 935.

Thomas, Hollie B. "The Effects of Sex, Occupational Choice and Career Development Responsibility on the Career Maturity of Ninth-Grade Students," 1974, ERIC ED 092 819.

Sex-Stereotyping of Careers

Entwisle, Doris R. and Greenberger, Ellen. "Adolescents' Views of Women's Work Role," American Journal of Orthopsychiatry 1972, 42, (4), 848-849.

*Erickson, Linda G. and Nordin, Margaret L. "Sex-Role Ideologies and Career Salience of College Women," 1974, ERIC ED 095 449.

Erlick, Arline C. and LeBold, William K. "Factors Influencing the Science Career Plans of High School Students," 1975, ERIC ED 111 649.

Hawley, Peggy. "Perceptions of Male Models of Femininity Related to Career Choice," Journal of Counseling Psychology 1972, 19, 308-313.

Hawley, Peggy. "The Relationship of Women's Perceptions of Men's Views of the Feminine Ideal to Career Choice," 1970, ERIC ED 046 031.

*Hawley, Peggy. "The State of the Art of Counseling High School Girls." ERIC ED 128 744, 1975.

Hawley, Peggy. "What Women Think Men Think: Does It Affect Their Career Choice?" Journal of Counseling Psychology 1971, 18, (3), 193-199.

*Kaley, Maureen M. "Attitudes Toward the Dual Role of the Married Professional Woman," American Psychologist 1971, 26, (3), 301-306.

Luchins, Edith H. "Women in Mathematics: Problems of Orientation and Reorientation," 1976, ERIC ED 129 634.

Matthews, Esther and Tiedeman, David V. "Attitudes Toward Career and Marriage and the Development of Life Style in Young Women," Journal of Counseling Psychology 1964, 11, (4), 375-383.

Schlossberg, Nancy K. and Goodman, J. "A Woman's Place: Children's Sex Stereotyping of Occupations." Vocational Guidance Quarterly, 1972, 20, (4), 266-270.

Parental Identification - Role Modeling

Almquist, Elizabeth M. and Angrist, Shirley S. "Role Model Influences on College Women's Career Aspirations," Merrill-Palmer Quarterly 1971, 17, (3), 263-279.

White, Becky J. "The Relationship of Self-Concept and Parental Identification to Women's Vocational Interests," Journal of Counseling Psychology 1959, 6, (3), 202-206.

Factors Discriminating Between Career vs. Homemaking Orientation

Astin, Helen S. "Career Development of Girls During the High School Years," Journal of Counseling Psychology 1968, 15, (6), 536-540.

Goldman, Roy D. et al. "Sex Differences in the Relationship of Attitude-Toward-Technology to Choice of Field of Study," 1973, ERIC ED 083 508.

Gysbers, Norman C. and Johnston, Joseph A. "Characteristics of Homemaker- and Career-Oriented Women," Journal of Counseling Psychology 1968, 15, (6), 541-546.

Rand, Lorraine. "Masculinity or Femininity? Differentiating Career-Oriented and Homemaking-Oriented College Freshman Women," Journal of Counseling Psychology 1968, 15, (5), 444-450.

Schissel, Robert F. "Development of a Career-Orientation Scale for Women," Journal of Counseling Psychology 1968, 15, (3), 257-262.

Sex Differences

Astin, Helen S., Harway, Michele and McNamara, Patricia. *Sex Discrimination in Education: Access to Post Secondary Education*. National Center for Education Statistics, Education Division, Department of Health, Education and Welfare, February 1976, 284 pp.

Looft, William R. "Sex Differences in the Expression of Vocational Aspirations by Elementary School Children." *Developmental Psychology*, 1971, *5*, (2), 366. (See also Looft, William R. "Vocational Aspirations of Second Grade Girls." *Psychological Reports*, 1971, *28*, 241-242).

*Michaels, J.W. "Rationale and Design for Reducing Sex Differences in Occupational and Educational Attainment by Stereotyping Across--Sex Peer Influence." Report No. 196 ED 114 754, 1975.

Career Development

Astin, Helen S. "Career Development of Girls During the High School Years." *Journal of Counseling Psychology*, 1968, *15*, (6), 536-540.

Astin, Helen S. *The Woman Doctorate in America: Origins, Career, and Family*. New York: Russell Sage Foundation, 1969, 196 pp.

Astin, Helen S. "Overview of the Findings." In H. Astin, H. Suniewick and S. Dweck, *Women: A Bibliography on Their Education and Careers*. New York: Behavioral Publications Incorporated, 1974, 1-10.

Fox, Lynn H. *Career Interests and Mathematical Acceleration for Girls*. Paper presented at the 1975 annual meeting of the American Psychological Association, Chicago, Illinois, August 1975b.

Fox, Lynn H. "Women and the Career Relevance of Mathematics and Science." *School Science and Mathematics*, 1976a, *26*, (4), 347-353.

Fox, Lynn H. "Sex Differences in Mathematical Precocity: Bridging the Gap." In Daniel P. Keating (Ed.), *Intellectual Talent: Research and Development* Baltimore, Maryland: The Johns Hopkins University Press, 1976b, 183-214.

Fox, Lynn H. "Facilitating the Development of Mathematical Talent in Young Women." (Doctoral dissertation, the Johns Hopkins University, 1974.) *Dissertation Abstracts International*, 1974, *35*, 3553B. (University Microfilms No. 74-29027)

Fox, Lynn H. *Sex Differences: Implications for Program Planning for the Academically Gifted*. Paper presented at the Lewis M. Terman Memorial Symposium on Intellectual Talent held at the Johns Hopkins University, Baltimore, Maryland, November 1975a.

Husbands, Sandra Acker. "Women's Place in Higher Education?" School Review. 1972, 80, (2), 261-274.

Luchins, Edith H. Women Mathematicians: A Contemporary Appraisal. Paper Presented at the 1976 meeting of the American Association for the Advancement of Science, Boston, February 1976.

Ory, John C. and Helfrich, Linda M. A Study of Individual Characteristics and Career Aspirations. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, California, April 1976.

Perrucci, Carolyn Cummings. "Minority Status and the Pursuit of Professional Careers: Women in Science and Engineering." Social Forces, 1970, 19, (2), 245-259.

Prediger, Dale J.; McLure, Gail T. and Noeth, Richard J. Promoting the Exploration of Personally Relevant Career Options in Science and Technology. Report to the National Science Foundation, October 1976.

Rossi, Alice S. "Women in Science: Why so Few?" Science, 1965a, 148 (3674): 1196-1202. Also in: Safilios-Rothschild, Constantina, (Ed.), Toward a Sociology of Women. Lexington, Massachusetts: Xerox College Publishing, 1972, 141-153.

Rossi, Alice S. "Barriers to the Career Choice of Engineering, Medicine or Science Among American Women." In J. Mattfeld and C. Van Aken (Eds.), Women and the Scientific Professions, Cambridge, Massachusetts: M.I.T. Press, 1965b, 51-127.

Smith, Walter Scott. Science Education in the Affective Domain: The Effect of a Self-Awareness Treatment on Career Choice of Talented High School Women. Paper presented at the national convention of the National Association for Research in Science Teaching, San Francisco, April 1976.

ANXIETY

General Anxiety

Freeman, M.J. "The Development of a Test for the Measurement of Anxiety," Psychological Monographs 1953, 67, No. 353, 12-19.

*Sarason, S. et al. Anxiety in Elementary School Children, John Wiley and Sons, Inc. 1960.

*Taylor, Janet A. "A Personality Scale of Manifest Anxiety," Journal of Abnormal and Social Psychology 1953, 48, 285-290.

Mathematics Anxiety

*Dreger, Ralph Mason and Aiken, Lewis R. Jr. "The Identification of

Number Anxiety in a College Population," Journal of Educational Psychology 1957, 48, 344-351.

*Fennema, Elizabeth and Sherman, Julia. "Mathematics Attitude Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." Journal Supplement Abstract Service of APA, Manuscript 1225, 1976.

Richardson, Frank C. and Suinn, Richard M. "The Mathematics Anxiety Rating Scale: Psychometric Data," Journal of Counseling Psychology 1972, 19, (6), 551-554.

*Sandman, Richard. "The Development, Validation and Application of a Multi-dimensional Mathematics Attitude Instrument." (Doctoral dissertation, University of Minnesota, 1972.

*Suinn, Richard M. et al. "The MARS, A Measure of Mathematics Anxiety: Psychometric Data," Journal of Clinical Psychology 1972, 28, 373-375.

Test Anxiety

*Alpert, Richard and Haber, Ralph. "Anxiety in Academic Achievement Situations," Journal of Abnormal and Social Psychology 1960, 61, (2), 207-215.

Feld, S.C. and Lewis, J. "The Assessment of Achievement Anxieties in Children," in C.P. Smith ed. Achievement Related Motives in Children 1959.

*Mandler, George and Cowen, Judith. "Test Anxiety Questionnaires," Journal of Consulting Psychology 1958, 22, (3), 228-229.

Szetela, Walter. "The Effects of Test Anxiety and Success/Failure on Mathematics Performance in Grad Eight," Journal for Research in Mathematics Education 1973, 152-160.

Tobias, Sheila. "Math Anxiety." Ms., September, 1976.

SELF-CONCEPT

General Self-Concept

Bachman, Alfred Morry. "The Relationship between a Seventh-Grade Pupil's Academic Self-Concept and Achievement in Mathematics," Journal for Research in Mathematics Education 1970, May, 173-179.

Brookover, W.B. and Patterson, S. Thomas. "Self-Concept of Ability and School Achievement," Cooperative Research Project 845. Office of Research and Publications. East Lansing: Michigan State University, 1962. ERIC ED 002 946.

*Coopersmith, Stanley. The Antecedents of Self-Esteem. San Francisco: W.H. Freeman, 1967.

Farrah, George A. "An Annotated Bibliography of Research Concerning the Self-Concept and Motivation Inventory (SCAMIN)," 1975, ERIC ED 084 595.

*Fennema, Elizabeth, and Sherman, Julia. "Mathematics Attitude Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." Journal Supplement Abstract Service of APA, Manuscript 1225, 1976.

Hales, Loyde W. and Yackee, Keith. "Self-Concepts, Sex, and Work Values," 1974, ERIC ED 090 459.

*Holly, Keith; Purl, Mabel C., Dawson, Judith A. and Michael, William B. "The Relationship of an Experimental Form of the Mathematics Self-Concept Scale to Cognitive and Noncognitive Variables for a Sample of Seventh-Grade Pupils in a Middle-Class Southern California Community," Educational and Psychological Measurement 1973, 33, 505-508.

Jandt, Fred E. "Sex Differences in the Factor Structure of Berger's Expressed Acceptance of Others Scale." 1973, ERIC ED 084 595.

Kameya, Mary Norris and Nadelman, Lorraine. "Relationship of Masculinity-Femininity to Dependency and Self-Esteem," 1972, ERIC ED 087 984.

Knapp, Joan. "A Selection of Self-Concept Measures," ERIC ED 080 534.

*Kulm, Gerald. "A Mathematics Self-Concept Test," ERIC ED 075 512.

Leviton, Harvey. "The Implications of the Relationship between Self-Concept and Academic Achievement," Child Study Journal 1975, 5, 25-35.

Mehrabian, Albert. "The Development and Validation of Measures of Affiliative Tendency and Sensitivity to Rejection," Educational and Psychological Measurement 1970, 30, 417-428.

*"National Longitudinal Study of Mathematics," Report Numbers 1, 2 and 3. SMSG. 1968.

Piers, Ellen V. and Harris, Dale B. "Age and Other Correlates of Self-Concept in Children," Journal Of Educational Psychology 1964, 55, 91-95.

Primavera, Louis H.; Simon, William E. and Primavera, Anne M. "The Relationship between Self-Esteem and Academic Achievement: An Investigation of Sex Differences," Psychology in the Schools 1974, 11, 213-216.

Purkey, William W. and others. "The Development of a 'Pupil Inventory' to Infer Learner Self-Concept," 1971, ERIC ED 050 153.

Rosen, Pamela (Ed.). "Self-Concept Measures; Grade 7 and Above," ERIC ED 083 319.

*Rosenberg, Morris. *Society and the Adolescent Self-Image*. Princeton, New Jersey: Princeton University Press, 1965.

*Sandman, Richard. "The Development, Validation and Application of a Multidimensional Mathematics Attitude Instrument." (Doctoral Dissertation, University of Minnesota, 1972).

Stanwyck, Douglas J. and Felker, Donald W. "Intellectual Achievement Responsibility and Anxiety as Functions of Self-Concept of Third to Sixth Grade Boys and Girls," 1971, ERIC ED 080 903.

MOTIVATION

Achievement

Fennema, Elizabeth. "Mathematics Learning and the Sexes: A Review," *Journal for Research in Mathematics Education* 1974, 126-139.

Hilton, Thomas L. and Berglund, Gosta W. "Sex Differences in Mathematics Achievement - A Longitudinal Study," *Journal of Educational Research* 1974, 67, (5), 235.

Achievement Motivation

Alper, Thelma G. "Achievement Motivation in College Women - A Now-You-See-It-Now-You-Don't Phenomenon," *American Psychologist* 1974, *29*, 194-203.

Atkinson, John W. and Litwin, George. "Achievement Motive and Test Anxiety Conceived as Motive to Approach Success and Motive to Avoid Failure," *Journal of Abnormal and Social Psychology* 1960, *60*, 52-63.

Bar-Tal, Daniel and Frieze, Irene Hanson. "Achievement Motivation and Gender as Determinants of Attributions for Success and Failure," 1975, ERIC ED 118 518.

*Crandall, V. in C.P. Smith, *Achievement Related Motives in Children*.

Crandall, V.J.; Katovsky, W. and Preston, A. "Motivational and Ability Determinants of Young Children's Intellectual Achievement Behaviors." *Child Development*, 1962, *33*, 643-661.

Fennema, Elizabeth and Sherman, Julia. "Sex Related Differences in Mathematics Learning: Myths, Realities, and Related Factors, 1976, ERIC ED 129 633.

*Fennema, Elizabeth and Sherman, Julia. "Mathematics Attitude Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." *Journal Supplement Abstract* Service of APA, Manuscript 1225, 1976.

Furst, Edward J. "Validity of Some Objective Scales of Motivation for Predicting Academic Achievement," *Educational and Psychological Measurement* 1966, *26*, 927-933.

*Hermans, Hubert J.M. "A Questionnaire Measure of Achievement Motivation," Journal of Applied Psychology 1970, 54, 353-363.

Hill, Kennedy T. and Jerome B. Duseck. "Children's Achievement Expectations as a Function of Social Reinforcement, Sex of S, and Test Anxiety," Child Development 1969, 40, 547-558.

Houts, Peter S. and Entwisle, Doris R. "Academic Achievement Effort Among Females: Achievement Attitudes and Sex-Role Orientation," Journal of Counseling Psychology 1968, 15, 284-286.

Maccoby, Eleanor E. "Sex Differences in Intellectual Functioning," in J.M. Bardwick ed. Readings on the Psychology of Women 1972.

*Mehrabian, Albert. "Male and Female Scales of the Tendency to Achieve," Educational and Psychological Measurement 1968, 28, 493-502.

Mehrabian, Albert. "Measures of Achieving Tendency," Educational and Psychological Measurement 1969, 29, 445-451.

*Myers, Albert E. "Risk Taking and Academic Success and Their Relation to an Objective Measure of Achievement Motivation," Educational and Psychological Measurement 1965, XXV (2), 355-363.

*Ory, John C. and Poggio, John P. "The Development and Empirical Validation of a Measure of Achievement Motivation," 1975, ERIC ED 124 567.

Poffenberger, Thomas and Norton, Donald. "Sex Differences in Achievement Motive in Mathematics as Related to Cultural Change," Journal of Genetic Psychology 1963, 103, 341-350.

psychology of Women - The Motive to Achieve.

*Russell, Ivan L. "Motivation for School Achievement: Measurement and Validation," Journal of Educational Research 1969, 62, (6), 263-266.

*Smith, Janice P. "Development of a Student Self-Report Scale of Achievement and Affiliation Motivation," 1976, ERIC ED 128 467.

Stein, Aletha Huston and Bailey, Margaret M. "The Socializaiotn of Achievement Orientation in Females," Psychological Bulletin 1973, 80, (5), 345-366.

Stein, Aletha Huston. "The Effects of Sex-Role Standards for Achievement and Sex-Role Preference on Three Determinants of Achievement Motivation," Developmental Psychology 1971, 4, (2), 219-231.

Veroff, Joseph. "Varieties of Achievement Motivation," 1975, ERIC ED 106 737.

Usefulness of Mathematics

*Fennema, Elizabeth and Sherman, Julia. "Mathematics Attitude Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." Journal Supplement Abstract Service of APA, Manuscript 1225, 1976.

*Husen T. (Ed.) International Study of Achievement in Mathematics, Vol. I, John Wiley and Sons, 1967.

*National Assessment of Educational Progress, Second Mathematics Assessment, Denver, Colorado 1977.

*Sandman, Richard. "The Development, Validation and Application of a Multidimensional Mathematics Attitude Instrument." (Doctoral dissertation, University of Minnesota, 1972).

Masculinity-Femininity

Barrows, Gordon A. and Zucherman, Marvin. "Construct Validity of Three Masculinity-Femininity Tests," Journal of Consulting Psychology 1960, 24, (5), 441-445.

*Bem, Sandra L. "The Measurement of Psychological Androgyny," Journal of Consulting and Clinical Psychology 1974, 42, (2), 155-162.

*Berdie, Ralph F. "A Femininity Adjective Check List," Journal of Applied Psychology 1959, 43, (5), 327-333.

Constantinople, Anne. "Masculinity-Femininity: An Exception to a Famous Dictum?" Psychological Bulletin 1973, 80, (5), 389-407.

Gonen, Jay Y. and Lansky, Leonard M. "Masculinity, Femininity, and Masculinity-Femininity: A Phenomenological Study of the Mf Scale of the MMPI," Psychological Reports 1968, 23, 183-194.

Nichols, Robert C. "Subtle, Obvious and Stereotype Measures of Masculinity-Femininity," Educational and Psychological Measurement 1962, 22, (3), 449-461.

*Sannito, Thomas; Walker, Ronald, Foley, Jeanne and Posavac, Emil. "A test of Female Sex Identification: The Thorne Femininity Study," Journal of Clinical Psychology 1972, 28, 531-539.

*Sherriffs, A.C. and Jarrett, R.F. "Sex Differences in Attitudes about Sex Differences," The Journal of Psychology 1953, 35, 161-168.

Spence, Janet T.; Helmreich, Robert and Stapp, Joy. "Likability, Sex Role Congruence of Interest, and Competence: It all Depends on How You Ask," Journal of Applied Social Psychology 1975, 5, (2), 93-109.

Locus of Control

Crandall, Virginia C.; Katkovsky, Walter and Crandall, Vaughn J. "Children's Beliefs in Their Own Control of Reinforcements in Intellectual-Academic Achievement Situations," *Child Development* 1965, *36*, 91-109.

Dweck, Carol S. and Bush, Ellen S. "Sex Differences in Learned Helplessness: I. Differential Debilitation with Peer and Adult Evaluators," *Developmental Psychology* 1976, *12*, (2), 147-156.

Dweck, Carol S. "Children's Interpretation of Evaluative Feed-back: The Effect of Social Cues on Learned Helplessness," *Merrill-Palmer Quarterly* 1976, *22*, (2), 105-123.

LaVoie, Joseph C. and Adams, Gerald R. "A Comparative Test of Locus of Control Measures and IQ as Predictors of Children's Task Performance," 1975, ERIC ED 118 248.

*Lefcourt, Herbert. *Locus of Control: Current Trends in Theory and Research*, Lawrence Erlbaum Assoc. 1976.

Lefcourt, Herbert M. "Internal Versus External Control of Reinforcement: A Review," *Psychological Bulletin* 1966, *65*, (4), 206-220.

Levenson, Hanna. "Reliability and Validity of the I, P, and C Scales - A Multidimensional View of Locus of Control," 1973, ERIC ED 087 791.

Medway, Frederic J. "Different Blames for Different Names: Divergent Self-Other Attributions for Success and Failure," 1975, ERIC ED 120 601.

Messer, Stanley B. "The Relation of Internal-External Control to Academic Performance," *Child Development* 1974, *43*, 1456-1462.

Thomas, Hollie B. "Underlying Constructs of Locus of Control of Reinforcement," 1975, ERIC ED 108 039.

Watson, David and Baumal, Evelyn. "Effects of Locus of Control and Expectation of Future Control Upon Present Performance," *Journal of Personality and Social Psychology* 1967, *6*, 212-215.

Zerega, William D., Jr. et al. "Stability and Concurrent Validity of the Rotter Internal-External Locus of Control Scale," ERIC ED 109 228.

Fear of Success

*Fennema, Elizabeth and Sherman, Julia. "Mathematics Attitude Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." *Journal Supplement Abstract* Service of APA, Manuscript 1225, 1976.

Griffore, Robert J. "Validation of Three Measures of Fear of Success," *Journal of Personality Assessment* 1977, *41*, (4), 417-421.

Horner, M.S. *Sex Differences in Achievement Motivation and Performance in Competitive and Noncompetitive Situations*. Unpublished Doctoral dissertation, University of Michigan, 1968.

Horner, Matina. "Femininity and Successful Achievement: A Basic Inconsistency," in J.M. Bardwick et al eds. *Feminine Personality and Conflict*, Brooks/Cole Publ. 1970.

Horner, Matina. "The Motive to Avoid Success and Changing Aspirations of College Women," in J.M. Bardwick ed. *Readings on the Psychology of Women*, 1972.

Lavach, John F. and Lanier, Hope B. "The Motive to Avoid Success in 7th, 8th, 9th, and 10th Grade High-Achieving Girls," *Journal of Educational Research* 1974-75, *68*, 216-218.

Levine, Maita. *Identification of Reasons Why Qualified Women do not Pursue Mathematical Careers*. Report to the National Science Foundation, August, 1976.

*Pappo, M. "Fear of Success: An Empirical and Theoretical Analysis," Unpublished Doctoral dissertation, Teachers College, Columbia University, 1972.

Romer, Nancy. "The Motive to Avoid Success and its Performance in School-Age Males and Females," *Developmental Psychology* 1975, *11*, (6), 689-699.

Solano, Cecilia H. *Teacher and Pupil Stereotypes of Gifted Boys and Girls*. Paper presented at the 1976 meeting of the American Psychological Association, Washington, D.C., September, 1976.

*Zuckerman, Miron and Allison, Stephen N. "An Objective Measure of Fear of Success: Construction and Validation," *Journal of Personality Assesment* 1976, *40*, (4), 422-430.

Parents

*Aiken, Lewis R. Jr. and Dreger, Ralph Mason. "The Effect of Attitudes on Performance in Mathematics," *Journal of Educational Psychology* 1961, *52*, (1), 19-24.

Aiken, Lewis R. "Affective Variables and Sex Differences in Mathematical Abilities," 1974, ERIC ED 089 997.

*Aiken, Lewis R. "Some Speculations and Findings Concerning Sex Differences in Mathematical Abilities and Attitudes," in Elizabeth Fennema ed. *Mathematics Learning: What Research Says About Sex Differences*, 1975, Columbus, Ohio: ERIC Mathematics, Science, and Environmental Education Clearinghouse, 13-20.

Poffenberger, Thomas and Norton, Donald. "Factors in the Formation of Attitudes Toward Mathematics," *Journal of Educational Research* 1959, *52*, (5), 171-176.

Rossi, Alice S. "A Biosocial Perspective on Parenting," *Daedalus*, American Academy of Arts and Sciences, 1977, *106*, (2), 1-31.

Tocco, Thomas S. "Student Attitudes, Perceived Parental Attitudes, and Socio-Economic Status as Predictors of Junior High School Mathematics Achievement," 1971, ERIC ED 052 017.

Parents' Attitude Toward Math

*Fennema, Elizabeth and Sherman, Julia. "Mathematics Attitude Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." *Journal Supplement Abstract* Service of APA, Manuscript 1225, 1976.

Hill, John P. "Similarity and Accordance Between Parents and Sons in Attitudes Toward Mathematics," *Child Development* 1967, *38*, 777-791.

Tocco, Thomas S. "Student Attitudes, Perceived Parental Attitudes, and Socio-Economic Status as Predictors of Junior High School Mathematics Achievement," 1971, ERIC ED 052 017.

Parents' Influence on Child's Peer Orientation

Hollander, Edwin P. and Marcia, James E. "Parental Determinants of Peer-Orientation and Self-Orientation among Preadolescents," *Developmental Psychology* 1970, *2*, 292-302.

Parental Expectations

Crandall, Vaughn et al. "Parents' Attitudes and Behaviors and Grade-School Children's Academic Achievements," *Journal of Genetic Psychology* 1964, *104*, 53-66.

Kaminski, Donna M. et al. "Why Females Don't Like Mathematics: The Effect of Parental Expectations." Paper presented at the 1976 American Sociological Association Meeting, New York City.

Sandis, Eva E. "The Transmission of Mothers' Educational Ambitions, as Related to Specific Socialization Techniques," *Journal of Marriage and the Family* 1970, 204-211.

Parents as Role Models

Banducci, Raymond. "The Effect of Mother's Employment on the Achievement, Aspirations, and Expectations of the Child," *Personnel and Guidance Journal* 1967, 263-267.

Baruch, Grace K. "Maternal Influences upon College Women's Attitudes toward Women and Work," *Developmental Psychology* 1972, *6*, 32-37.

Carlsmith, Lyn. "Effect of Early Father Absence on Scholastic Aptitude." *Harvard Educational Review*. 1964, *34*, (1), 3-21.

Johnson, Ray W. "Parental Identification and Vocational Interests of College Women," Measurement and Evaluation in Guidance 1970, 3, (3), 147-151.

Vogel, Susan R. et al. "Maternal Employment and Perception of Sex Roles among College Students," Developmental Psychology 1970, 3, 384-391.

Teacher

Attitude Toward Math

Dutton, Wilbur H. "Prospective Elementary School Teachers' Understanding of Arithmetical Concepts," Journal of Educational Research 1965, 58, (8), 362-365.

Hunkler, Richard and Quast, W.G. "Improving the Mathematics Attitudes of Prospective Elementary School Teachers," School Science and Mathematics 1972, 72, 709-714.

*Stright, Virginia. "A Study of Attitudes toward Arithmetic and Teachers in the Third, Fourth and Sixth Grades," Arithmetic Teacher 1960, 7, (6).

Teacher Encouragement

Anderson, Kenneth E. "A Comparative Study of Student Self-Ratings on The Influence of Inspirational Teachers in Science and Mathematics in the Development of Intellectual Curiosity, Persistence, and a Questioning Attitude," Science Education 196 , 47, (5), 429-437.

Casserly, Patricia L. "The Advanced Placement Teacher as the Critical Factor in High School Women's Decision to Persist in the Study of Mathematics," Paper Presented at AERA, 1979.

Good, Thomas L.; Sikes, J. Neville and Brophy, Jere. "Effects of Teacher Sex and Student Sex on Classroom Interaction," Journal of Educational Psychology 1973, 65, (1), 74-87.

*Fennema, Elizabeth and Sherman, Julia. "Mathematics Attitude Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." Journal Supplement Abstract Service of APA, Manuscript 1225, 1976.

Husen, T. (Ed.) International Study of Achievement in Mathematics, John Wiley and Sons, New York, 1976 (2 volumes).

Sanderson, Goulding E. and Anderson, Kenneth E. "A Study of the Influence of an Inspirational Science or Mathematics Teacher Upon Student Achievement as Measured by the National Merit Qualifying Test." School Science and Mathematics, 1960, 60, 339-345.

*Sandman, Richard. "The Development, Validation and Application of a Multidimensional Mathematics Attitude Instrument." (Doctoral dissertation, University of Minnesota, 1972).

Teacher Differential Treatment of the Sexes

Bean, Joan P. *What's Happening in Mathematics and Science Classrooms, Student Teacher Interactions*. Paper presented at the Meeting of the American Educational Research Association, San Francisco, California, 1976.

Good, Thomas L. and J. Neville Sikes and Jere Brophy. "Effects of Teacher Sex and Student Sex on Classroom Interaction," Journal of *Educational Psychology*, 1973, 65, (1), 74-87.

Sears, Pauline S. and David H. Feldman. "Teacher Interactions with Boys and With Girls," *National Elementary Principal*, 1966, 46, 30-35.

Counselor

*Bingham, W. and House, E. "Counselors View Women and Work: Accuracy of Information," *Vocational Guidance Quarterly*, 21, (4), 1973.

Engelhard, P. and K. Jones. "Trends in Counselor Attitude About Women's Roles," *Journal of Counseling Psychology*, 23, (4), 1976.

Harway, Michele; Astin, Helen; Suhr, Jeanne and Whitely, John. *Sex Discrimination in Guidance and Counseling*. National Center for Education Statistics, Educational Division, U.S. Department of Health, Education and Welfare, February, 1976, 271 pp. (annotated bibliography under separate cover)

Hawley, Peggy. "The State of the Art of Counseling High School Girls," 1975, ERIC ED 128 744.

Lipman-Blumen, Jean. *Vicarious Achievement Roles for Women?: A Serious Challenge to Guidance Counselors*. Unpublished paper. Also appears untitled in *Personnel and Guidance Journal*, 1975, 53, (9), 680.

Shapiro, Johanna. "Socialization of Sex Roles in the Counseling Setting: Differential Counselor Behavioral and Attitudinal Responses to Typical and Atypical Female Sex Roles," 1975, ERIC ED 106 727.

Thomas, A.H. and Stewart, N.R. "Counselor Response to Female Clients with Deviate and Conforming Career Goals," *Journal of Counseling Psychology*, 1971, 18, 352-357.

Socioeconomic Status

Coleman, James S. et al, *Equality of Educational Opportunity*, National Center for Education Statistics, 1966.

Intervention Programs

Schwandt, A. N. Kreinberg and D. Downie, *Use Equals to Promote the Participation of Women in Mathematics*, University of California, 1980.

Koltnow, Joanne, *Expanding Your Horizons in Science and Mathematics: A Handbook for Planners*, 1979.

APPENDIX A

STUDY VARIABLES AND THEIR DEFINITIONS

LIST OF STUDY VARIABLES

I. Sex-Role Stereotyping

   A. General Sex-Role Stereotyping
   B. Mathematics as a Male Domain
   C. Men's Attitudes Toward Women Who Are Successful in Mathematics

II. Career Plans

   A. Career Aspirations
   B. Mathematics Preparation Required for a Job
   C. Factors Influencing Career Choice

III. Mathematics and Oneself

   A. Confidence in Mathematics
   B. Anxiety in Mathematics
   C. Anxiety in English
   D. Anxiety in School
   E. Enjoyment of Mathematics
   F. Locus of Control
   G. Mathematics and Oneself Composite

IV. Usefulness of Mathematics to the Individual

V. Academic Plans

   A. Educational Aspirations
   B. Taking More Mathematics (13-year-olds)
   C. Factors Influencing the Decision to Take More Mathematics

VI. Parental Influences (Mother and Father Separately)

   A. Father as a Role Model
   B. Mother as a Role Model
   C. Father's Encouragement in Mathematics
   D. Mother's Encouragement in Mathematics
   E. Father's Stereotyping of Mathematics
   F. Mother's Stereotyping of Mathematics
   G. Helping with Homework
   H. Who Uses More Mathematics
   I. Father's Educational Expectations
   J. Mother's Educational Expectations
   K. Family Status

VII. Influences of Significant Others

  A. Peer Influence
  B. Peer Stereotyping of Mathematics
  C. Counselor Encouragement to Take More Mathematics
  D. Teacher Encouragement in Mathematics
  E. Teacher Stereotyping of Mathematics
  F. Teacher Differential Treatment
  G. Sibling Role Models

VIII. School Experience

  A. Mathematics Participation (Course-Taking Grade 12)
  B. Type of School Program (Grade 12)
  C. Grades in Mathematics
  D. Algebra in Grade 8

IX. Achievement in Mathematics

  A. Computation
  B. Algebra
  C. Problem Solving
  D. Spatial Visualization
  E. Achievement Composite

X. Background variables

  A. Father's Education
  B. Mother's Education
  C. Father's Occupation
  D. Mother's Occupation
  E. Items in the Home
  F. Socioeconomic Status

This appendix gives conceptual definitions and detailed descriptions of scales and individual items used in this study. Technical definitions and cutoffs for certain variables are also included.

I. Sex-Role Stereotyping

A. General Sex-Role Stereotyping

It seems likely that females with "traditional" views about sex roles, would not perceive mathematics as being very useful in their future adult lives. Consequently, they would be less likely to enroll in advanced mathematics courses than more "contemporary" females or males.

This scale places respondents on a contemporary/traditional continuum with respect to their attitudes toward sex roles. Likert-type items address three different components of sex-role stereotyping:

1. Dual role of women. Items ask respondents' opinions about whether women can have successful careers and raise families at the same time.
2. Spousal responsibilities. Items measure attitudes about who should be responsible for the housekeeping and raising the children.
3. Equality of the sexes. Should women have the same opportunities and rewards in life as men, and do men and women have the same abilities?

A high scale score on stereotyping scales indicates a "contemporary" view of stereotyping--e.g. the opinion that there should be no differences between the roles, responsibilities and equality of the sexes.

B. Mathematics as a Male Domain

Although this variable may be a component of general sex-role stereotyping, it is mathematics-specific and treated as a separate variable in this study. Being "mathematics-specific," this variable could have a more "direct" influence than general sex-role sterotyping on female course-taking and achievement. Significant others investigated in this study (parents, teachers, counselors, peers and siblings) could have a large influence on a student's stereotyping of mathematics or general sex-role stereotyping. Likert-type items in this scale measure the extent to which respondents regard mathematics as more appropriate for males than for females and deal with the following topics:

1. The relative natural abilities of males and females in doing mathematics and in careers using mathematics.

2. The "masculinity" of women who pursue or who are good in mathematics.

3. The relative needs of males and females for a knowledge of mathematics.

C. Men's Attitudes Toward Women Who Are Successful in Mathematics

Researchers have suggested that women's opinions concerning the femininity of females who are successful in mathematics is not nearly so important as what they think men believe. Thus, social consequences of success in mathematics, such as loss of appeal to men, are the real issues and are thus the subjects of the Likert items in this scale. Female scores on this scale provide an indication of the level of concern females have for this problem and how this concern relates to mathematics course taking. Male responses should reveal the extent to which women's concerns are justified.

A high score on these three scales indicates a "contemporary" view point with regard to stereotyping mathematics as a field which is only for men. For example, a high score would indicate that mathematics is just as much for women as it is for men.

II. Career Plans

A. Career Aspirations

This variable is measured by an item which asks the student to select the occupational category which would include the job he or she hopes to have as an adult. (The same categories are used to determine the father's occupation and the mother's occupation, an important factor in determining socioeconomic status.) Career aspirations seem to be an important link in the chain of variables leading to course-taking and achievement. For males or females, career choice should relate to their perceived usefulness of mathematics for a career or for the academic preparation required for a career.

A revised version of Coleman's (1966) occupational categories is used. The eight occupational categories are collapsed into four groups, and the resulting set is treated as a continuous variable for correlational purposes. The four groups are:

1) Semi-skilled Workers

2) Clerical, technical, service personnel, skilled workers and homemakers

3. Management and Marketing Personnel

4. Professionals, executives and artists.

These same groups are used in quantifying parental occupation.

B. Mathematics Preparation Required for Job

While career aspirations should logically relate to mathematics course-taking, a more directly related variable would be the student's perception (accurate or not) of the amount of mathematics required for his or her chosen career. Accordingly, a single item measures this variable by asking the respondents how much mathematics preparation is needed to get into their chosen careers.

C. Factors Influencing Career Choice

The respondents are asked to indicate how important each of eleven factors will be in making their career choices. This set of items is intended to directly determine the relative importance of many of the facotrs which the rest of the survey questions address individually (e.g., mother, father, teacher, counselor, amount of mathematics needed, etc.). Two additional items measure the effects of the knowledge that a job 1) requires the use of mathematics, or 2) is traditionally done by members of the opposite sex, would have on respondents' decisions about taking such jobs. These two items not only measure the importance of these two factors, but also the "direction" of influence of each.

III. Mathematics and Oneself

Factor analysis of pilot data was used to help identify factors within the Mathematics and Oneself category. The three independent factors that emerged are confidence, anxiety and enjoyment. Although scales measuring motivation in mathematics are frequently included in batteries of affective instruments in mathematics, the present study does not include one. Both enjoyment of mathematics and mathematics participation can be considered measures of motivation.

The popular press has given a great deal of attention to "math anxiety," "mathophobia" and "math avoidance." The literature suggests there is strong relationship between confidence in mathematics and course participation, and that this relationship is different for the two sexes (i.e., males and females with a lot of confidence in mathematics tend to take more mathematics as do males with moderate confidence, but girls with only moderate confidence do not).

Previous research found sex differences in the expressed liking of mathematics at the college level, but generally not during the pre-college years.

Nevertheless, enjoyment of mathematics could be like confidence and show different patterns of influence on participation within sexes.

A. Confidence in Mathematics

Likert items in this scale measure students perceptions of how good and how confident they are in mathematics and whether they have the potential to be good in mathematics. A high scale score indicates a high degree of confidence in mathematics.

B. Anxiety in Mathematics

Items in this scale deal with students' feelings of uneasiness doing mathematics, taking tests in mathematics class, and with feelings of anxiety toward mathematics in general.

In order to differentiate between students who are generally anxious and those whose anxiety is mathematics-specific, "parallel" scales have been developed for Anxiety in School and Anxiety in English. A high score on the anxiety scale indicates low anxiety.

C. Enjoyment of Mathematics

This scale includes items on students' enjoyment of mathematics in general, doing mathematics and attending mathematics class. Some items deal with students' desire to take mathematics beyond the basic requirement or with their satisfaction in solving difficult problems.

D. Locus of Control in Mathematics

Locus of control is measured by a single item which states "Doing well in mathematics is entirely up to me." A high score indicates agreement with this statement and an "internal" attitude toward control.

E. Mathematics and Oneself Composite

An individual's scale score on enjoyment, confidence and anxiety in mathematics are averaged together to give this composite measure of "mathematics and oneself". A high score indicates a positive attitude toward mathematics.

IV. Usefulness of Mathematics to the Individual

The research literature suggests that there are major differences between the sexes with respect to the perceived usefulness of mathematics, and this variable is strongly related to course-taking. Likert items in this scale address two components of usefulness: 1) usefulness in daily life, and 2) usefulness to career and educational plans.

A high score indicates an attitude that mathematics is useful to the individual.

V. Academic Plans

A. Educational Aspirations

One item asks the student the highest level of education he or she expects to complete.

For correlational purposes, the five levels of education are treated as a continuous variable.

B. Taking More Mathematics (Intended Participation)

A single item asks thirteen-year-olds how may years of mathematics they plan to take in high school. Course names were not used in this item because many thirteen-year-olds would not know what they meant. Since thirteen-year-olds have had little choice regarding course-taking decisions, this variable is used as a dependent variable for thirteen-year-olds (as opposed to past course participation used for the high school seniors).

For correlations of participation and other study variables, intended participation was divided into three groups: 0-2 years, 3 years and 4 years.

C. Factors Influencing the Decision to Take More Mathematics

Thirteen-year-olds are asked to indicate how important each of nine factors will be in making decisions about taking additional mathematics courses. Seniors are asked how important the same nine factors were in making decisions about taking mathematics courses in high school. These items, like those on Factors Influencing Career Choice, are intended to directly measure the relative importance of many of the factors which the rest of the survey exercises address individually (e.g., parents, teachers, usefulness, etc.).

VI. Parental Influences (Mother and Father Separately)

Research suggests that parents influence a student's course-taking, achievement in mathematics and career aspirations via modeling, direct encouragement and expressions of attitudes toward mathematics. Items in this and the next variable category measure the students' perceptions of various attitudes, abilities and behaviors of parents. There are separate but parallel items and scales pertaining to mothers and fathers. These items are intended to determine which parental influences seem to be most important and to determine the nature of the interrelationships among these influences, sex of parent and sex of offspring.

A. Parents as Role Models

The items in these two scales deal with mothers' and fathers' feeling toward, abilities in, and use of mathematics. They measure a form of "passive" influence, the results of the examples the parents themselves set.

B. Parents' Encouragement in Mathematics

These scales measure students' perceptions regarding active encouragement given them by their mothers and fathers and their parents' opinions of the students as learners of mathematics. A clear distinction is made between role modeling and "active" encouragement. It is assumed that even if a parent has very limited abilities in mathematics, he or she can still exert a strong positive influence on offspring through direct encouragement. Frequently in previous research, this distinction has not been made. A high scale score indicates the student has perceived the parent as being encouraging.

C. Parents' Stereotyping of Mathematics

Single items determine whether or not respondents believe their parents think mathematics is "more for males than for females." These items parallel others in the Peer Influence, Teacher Encouragement and Mathematics as a Male Domain scales. A high score indicates a lack of stereotyping.

D. Parents Helping with Homework

A single item determines which parent helps the student most (if at all) with mathematics homework.

E. Who Uses More Mathematics

A single item asks which parent uses more mathematics in the home--mother, father or both about the same. This is another question which gets at role-modeling.

F. Parents' Educational Expectations for Offspring

These items ask the respondents to indicate the highest level of education each parent expects them to complete. The levels of education from which the students can choose are identical to those in the item measuring the students' own educational aspirations.

G. Family Status

One might expect different patterns of parental influence to be reflected in survey results for students from single-parent families. So that family status can be controlled, a question has been included in the survey which determines whether a respondent lives with both parents (or guardians) or just one parent--mother or father. An additional question asks students who live with just one parent if they see the other parent often, indicating an opportunity for influence.

VII. Influence of Significant Others

A. Peer Influence

The lower participation of females in mathematics is sometimes attributed to the desire for social acceptance. Do students perceive being good in mathematics as being detrimental to one's relationship with peers? This appears to be a particular problem for females and would probably be closely associated with stereotyping of mathematics as a male domain. This scale does not deal with the femininity of women who take mathematics, but rather deals with what one's friends think about people who are good in mathematics, whether one tries to hide one's success in mathematics or whether one tries to avoid success in mathematics altogether. These are related to Horner's notions of fear of success or motivation to avoid success.

A high score on this scale indicates that peer influence is positive and tends to encourage mathematics participation (e.g. one doesn't hide success in mathematics, friends have a high regard for people who take mathematics).

B. Peer Stereotyping of Mathematics

Two items in this category parallel items described in the parents' section. They ask the respondents whether the boys and girls among thier friends think mathematics is more for males than for females.

A high score on this item indicates disagreement with each statement.

C. Counselor Engouragement to Take More Mathematics (Twelfth Grade Only)

The one item in this category measures the extent to which a school counselor has encouraged or discouraged the respondent to take more mathematics. Many students had never been counseled and they were eliminated from analyses using this question.

D. Teacher Encouragement in Mathematics

Items in this scale deal with students perceptions regarding direct encouragement given them by their teachers and teachers' opinions of the students as learners of mathematics. Many of these items parallel those in the Parental Encouragement category.

E. Teacher Stereotyping of Mathematics

The stereotyping item described earlier has been modified to apply to the respondent's perception of mathematics teachers' attitudes -- whether mathematics teachers think mathematics is more for males than for females. This item is also in the Teacher Differential Treatment scale.

A high score indicates disagreement with this statement.

F. Teacher Differential Treatment

Research suggests that teachers behave differently toward male students than toward female students. Some kinds of differential expectations, encouragement and reinforcement of males versus females could be determental to the achievement, confidence and future mathematics participation of students of one sex. Items in this category address these three aspects of teacher behavior.

A high score indicates a lack of differential treatment. Teachers are perceived as treating males and females equally in mathematics class.

G. Sibling Role Models

Two items determine whether or not a student has an older brother or sister who is good in mathematics.

VIII. School Experience

A. Mathematics Participation (Course-Taking)

This variable is one of the most important dependent variables in the study. A series of questions determines which mathematics courses twelfth graders have taken or are taking.

For purposes of analysis, participation was defined as having four levels. In the lowest participation group, students had completed a mathematics course in general mathematics and/or Algebra II, but nothing higher. In the second group, students completed Geometry and/or Algebra II. Students categorized in the third participation group completed Trigonometry and/or Probability/Statistics. Students in the highest participation group completed Pre-Calculus and/or Calculus while in high school.

B. Type of School Program

Twelfth graders are asked whether the emphasis of their high school courses is general, vocational or college preparatory.

C. Grades in Mathematics

A single item asks respondents to indicate which of five grade categories best describes the grades they have gotten in mathematics.

D. Algebra in Eighth Grade

A single item asks students if they took (or intended to take) algebra while in eighth grade.

IX. Achievement in Mathematics

The scales in this category listed below consist of items from the existing instruments indicated. Performance on these scales will be investigated separately, but for some analyses a composite mathematics achievement score will be used, probably based on the first three scales only.

A. Computation--Stanford Achievement Test

B. Algebra--Cooperative Algebra I

C. Problem Solving--Metropolitan Achievement Tests

D. Spatial Visualization--Revised Minnesota Paper Form Board

E. Achievement Composite

This is the average of students scores on computation, alegra and problem solving. For categorization and correlational purposes, achievement was divided into thirds based on a student's raw score (number correct) on the composite measure. Cut-off scores are shown below:

	Grade 12	Age 13
Low Achievement	0-19	0-10
Moderate Achievement	20-29	11-16
High Achievement	30-44	17-34

These cut-off points yield approximately equal frequencies in each of the categories.

X. Background Variables

A. Age or Grade

13-year-olds were eligible for the sample if they were born during 1965.

Seniors were eligible for the sample if they were presently enrolled in the 12th grade.

The oversample population for the grade 12 sample was composed of males and females who had completed trigonometry and/or a course considered more advanced (e.g. advanced algebra, analysis, analytic geometry, functions, pre-calculus or calculus).

B. Socioeconomic Status (SES)

SES is a composite measure of the sum of items in the home, parents education, and parents occupation. Factor analysis indicated equal factor loadings for items in the home, father's education, mother's education, father's occupation and mother's occupation.

C. Parents Education

The same levels of education were used for parents education as were used in the item asking the highest level of education the student expected to complete.

D. Parents Occupation

The same occupational categories were used for parents as were used for students career plans. Eight categories of occupations were listed, but were collapsed into four groups for reporting and correlational purposes.

APPENDIX B

Instruments

This appendix includes the final instruments used in this study. The number in parentheses after each item indicates its package location in the survey instrument. For both ages, the survey instrument was divided into ten sections.

I. Attitudes
II. Mathematics Background
III. More Attitudes
IV. Computation
V. Problem Solving
VI. Parents' Attitudes
VII. Algebra
VIII. Teachers' and Friends' Attitudes
IX. Space Relations (Spatial Visualization)
X. Careers

Items administered to both populations have the same package location. Reliability coefficients based on the national survey are indicated at the end of each scale.

The cognitive achievement items are not included here because they were secured from standardized tests and used by permission. Source Documentation for the cognitive items appears in Appendix C.

I.A. General Sex-Role Stereotyping

1. If a man and a woman are equally qualified for a job, the man should get hired. (I-3)
2. I would never vote for a woman to be president of the United States, even if she were well qualified. (I-7)
3. A college education is more important for boys than for girls. (I-20)
4. Married women should work only if their families need the money. (I-29)
5. It is possible for a woman to have a successful career and be a good wife and mother. (I-33)
6. If a girl plans to get married, she does not need to think about a career. (III-8)
7. If I marry, I want the husband to work and the wife to take care of the home and family. (III-14)
8. A mother should not have a job while her children are young. (III-18)
9. A woman can be very successful in a career and still have an interesting social life. (III-24)
10. A wife's professional career is as important as her husband's. (III-29)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.74	.75
Grade 12	.80	.78

I.B. Mathematics as a Male Domain

1. Just as many women could be good scientists or engineers as men. (1-5)
2. Men need to know more mathematics than women. (I-8)
3. Girls can do just as well as boys in mathematics. (I-14)
4. Women do not do as well as men in jobs that use a lot of mathematics. (I-17)
5. Fewer females than males have the logical ability to become mathematicians. (I-30)
6. Men are naturally more able than women in scientific and technical fields. (I-35)
7. I would expect a female mathematician to be somewhat masculine. (Masculine means looking or acting like men.) (III-1)
8. Mathematics is more for males than for females. (III-12)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.75	.73
Grade 12	.79	.74

I.C. Men's Attitudes Toward Women Who Are Successful in Mathematics

1. Most men would prefer to work with other men as colleagues or associates. (I-13)
2. A man would probably feel uncomfortable around a woman who is a "brain" in mathematics or science. (I-26)
3. Men do not like to date women who are good in mathematics. (I-40)
4. Most men would NOT want to marry a woman interested in becoming a scientist or mathematician. (III-3)
5. Women who are good in mathematics do not generally appeal to men. (III-6)
6. Women who are good in mathematics tend NOT to be very feminine. (III-30)

	Male	Female
Age 13	.60	.65
Grade 12	.69	.66

II.A. Career Plans

1. What job or career do you plan to have? Write the name of your career in the space provided on the answer sheet. (X-14)

2. Look at the groups of careers below. In which group of careers does yours belong? Mark the letter of the group on your answer sheet. You may not find your exact career listed, but mark the one group in which you think it would fall. (X-16)

   A. ARTISTS AND ENTERTAINERS--such as a writer, journalist, artist, musician, actor/actress, designer, professional athlete, etc.

   B. CLERICAL, TECHNICAL AND SERVICE PERSONNEL--such as a bank teller, sales clerk, office worker, dental or medical technician, draftsman, computer programmer, policeman/policewoman, fireman, postal worker, nurse, etc.

   C. EXECUTIVES--such as a president or vice president of a large company, banker, government official or district manger, etc.

   D. HOMEMAKER

   E. MANAGEMENT AND MARKETING PERSONNEL--such as a store manager, insurance agent, owner of a small business, restaurant owner, real estate agent, sales representative, military officer, contractor, airline pilot, etc.

   F. PROFESSIONALS--such as a doctor, lawyer, teacher, librarian, social worker, accountant, architect, physicist, minister, vetinarian, forester.

   G. SEMI-SKILLED WORKERS--such as a factory machine operator, keypunch operator, truck driver, factory worker, security guard, farm worker, waiter/waitress, cab or bus driver, laborer, gas station attendant, etc.

   H. SKILLED WORKERS--such as a carpenter, plumber, mechanic, enlisted military person, farmer, tool and die worker, butcher, flight attendant, etc.

   I. I don't know.

II.B. Mathematics Preparation Required for a Job

How much mathematics do you think is needed to get into the career you have chosen?

A. None
B. Some high school mathematics
C. Four years of high school mathematics
D. Some college mathematics
E. A lot of college mathematics

II.C. Factors Influencing Career Choice

When the time comes for you to choose a career (careers would include homemaking as well as other occupations), how important will each of the following factors be in your decision about taking a particular job? The answer choices are "Not Important at All", "Not Important", "Undecided", "Important", and "Very Important." (X-1-11)

		Not Important At All	Not Important	Undecided	Important	Very Important
1.	What your mother thinks	A	B	C	D	E
2.	What your father thinks	A	B	C	D	E
3.	What your future husband or wife would think	A	B	C	D	E
4.	What your school counselor thinks	A	B	C	D	E
5.	What your teachers think	A	B	C	D	E
6.	Whether you could do the job well	A	B	C	D	E
7.	Whether you would enjoy the job	A	B	C	D	E
8.	Whether it is an important job	A	B	C	D	E
9.	Whether the job is traditionally done only by men or only by women	A	B	C	D	E
10.	Amount of education needed for the job	A	B	C	D	E
11.	Amount of mathematics needed for the job	A	B	C	D	E

Suppose a job you were considering would require you to use some mathematics. How would this affect your decision about taking the job? Choose only one answer. (X-12)

A. It would definitely be a reason for me to take the job.
B. It might be a reason for me to take the job.
C. It would not matter to me.
D. It might be a reason for me NOT to take the job.
E. It would definitely be a reason for me NOT to take the job.

Suppose a job you were considering were a job normally done by members of the opposite sex. How would this affect your decision about taking the job? Choose only one answer. (X-13)

A. It would definitely be a reason for me to take the job.
B. It might be a reason for me to take the job.
C. It would not matter to me.
D. It might be a reason for me NOT to take the job.
E. It would definitely be a reason for me NOT to take the job.

III.A. Confidence in Mathematics

1. Mathematics is easier for me than it is for most people. (I-1)
2. I am not very good at working mathematics problems. (I-18)
3. I am confident in mathematics. (I-31)
4. I just cannot understand mathematics. (I-34)
5. I usually feel confident when taking mathematics tests. (I-36)
6. I am very proud of my mathematics school work. (I-38)
7. I can get good grades in mathematics. (III-7)
8. I am no good in mathematics. (III-16)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.86	.88
Grade 12	.89	.87

III.B. Anxiety in Mathematics

1. Mathematics does not scare me at all. (I-19)
2. I dread mathematics class. (I-24)
3. Mathematics teachers make me more nervous than other teachers. (I-25)
4. I usually do not worry about mathematics. (I-32)
5. Taking mathematics tests scares me. (III-5)
6. Working mathematics problems makes me tense. (III-17)
7. I usually have been at ease during mathematics tests. (II-22)
8. I am usually at ease in mathematics class. (III-27)
9. Doing mathematics problems is usually frustrating. (III-28)
10. I dread being called on in mathematics class. (III-32)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.85	.88
Grade 12	.91	.93

III. C. Anxiety in School

1. Taking tests in school scares me. (I-2)
2. School classes do not scare me at all. (I-6)
3. I am usually at ease in school classes. (I-21)
4. Doing schoolwork makes me feel tense. (III-4)
5. Schoolwork is usually frustrating. (III-21)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.59	.62
Grade 12	.72	.70

III.D. Anxiety in English

1. I am usually at ease in English class. (I-11)
2. English assignments are usually frustrating. (I-15)
3. Taking tests in English class scares me. (I-23)
4. Doing English assignments makes me feel tense. (I-28)
5. English class does not scare me at all. (III-15)
6. I dread English class. (III-25)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.76	.79
Grade 12	.86	.88

III.E. Enjoyment of Mathematics

1. Working with numbers is fun. (I-4)
2. I have never liked mathematics. (I-27)
3. I enjoy mathematics classes. (I-37)
4. Mathematics fascinates me. (III-2)
5. Solving mathematics problems is boring. (III-9)
6. Solving a hard mathematics problem is exciting. (III-11)
7. I do not enjoy working mathematics problems. (III-19)
8. I would like to spend more time in school doing mathematics. (III-26)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.88	.89
Grade 12	.91	.92

III. F. Locus of Control

1. How well I do in mathematics is entirely up to me (I-10)

IV. Usefulness of Mathematics to the Individual

1. I need to know basic arithmetic, but I will not need to know any more mathematics than that. (I-9)
2. Taking mathematics is a waste of time for me. (I-12)
3. I will use mathematics in many ways as an adult. (I-16)
4. I probably will not need mathematics in my future work. (I-22)
5. Knowing mathematics will help me better understand the world about me. (I-39)
6. Mathematics is useful in my daily life. (III-10)
7. Not taking high school mathematics would seriously limit jobs that are available to me. (III-13)
8. Mathematics is important to my future educational plans. (III-20)
9. I cannot see how mathematics will be very useful to me outside of school. (III-23)
10. Knowing mathematics will help me get a good job. (III-31)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.78	.79
Grade 12	.88	.88

V.A. Educational Aspirations

What is the highest level of education you expect to complete? (II-3)--Age 13; (II-15)-- Grade 12

A. High school
B. Vocational, trade or technical school
C. Two-year college
D. Four-year college or university
E. Graduate or professional school after college

V.B. Taking more Mathematics-- Age 13

In the four years from grades nine through twelve, how many years do you think you might take mathematics? (II-1)

A. None
B. 1 year
C. 2 years
D. 3 years
E. 4 years

V.C. Factors Influencing the Decision to Take More Mathematics--Age 13

How important will each of the following factors be in deciding whether or not you take more mathematics courses in high school than are required? The answer choices are "Not Important At All," "Not Important," "Undecided," "Important" and "Very Important." (VIII-36-44)

	Not Important At All	Not Important	Undecided	Important	Very Important
1. What your mother thinks	A	B	C	D	E
2. What your father thinks	A	B	C	D	E
3. What your school counselor thinks	A	B	C	D	E
4. What your mathematics teachers think	A	B	C	D	E
5. How much you like or dislike mathematics	A	B	C	D	E
6. How good or bad you are in mathematics	A	B	C	D	E
7. How useful you think mathematics will be in getting into college or getting a job	A	B	C	D	E
8. Whether you friends take mathematics	A	B	C	D	E
9. Whether your classmates approve of people who take a lot of mathematics	A	B	C	D	E

V.C. Factors Influencing the Decision to Take More Mathematics--Grade 12

How important was each of the following factors in deciding whether or not you took more mathematics courses in high school than are required? The answer choices are "Not Important At All," "Not Important," "Undecided," "Important," and "Very Important." (VIII-36-44)

	Not Important At All	Not Important	Undecided	Important	Very Important
1. What your mother thought	A	B	C	D	E
2. What your father thought					
3. What your school counselor thought					
4. What your mathematics teachers thought					
5. How much you liked or disliked mathematics					
6. How good or bad you were in mathematics					
7. How useful you thought mathematics would be in getting into college or getting a job					
8. Whether your friends took mathematics					
9. Whether your classmates approved of people who take a lot of mathematics					

VI.A. Father as Role Model

1. My father likes mathematics. (VI-11)

2. My father is good in mathematics. (VI-19)

3. How often does your father use mathematics? (VI-25)

   A. Often
   B. Sometimes
   C. Rarely
   D. Never

Hoyt Reliability Coefficients

	Male	Female
Age 13	.77	.76
Grade 12	.80	.80

4. Who uses more mathematics in your home? (VI-24)

   A. Your mother
   B. Your father
   C. Both your mother and father about the same

VI.B. Mother as Role Model

1. My mother likes mathematics. (VI-12)

2. My mother is good in mathematics. (VI-20)

3. How often does your mother use mathematics? (VI-26)

   A. Often
   B. Sometimes
   C. Rarely
   D. Never

Hoyt Reliability Coefficients

	Male	Female
Age 13	.76	.73
Grade 12	.77	.72

4. Who uses more mathematics in your home? (VI-24)

   A. Your mother
   B. Your father
   C. Both your mother and father about the same

VI.C. Father's Encouragement in Mathematics

1. My father thinks advanced mathematics is a waste of time for me. (VI-3)
2. My father has not seemed to care how well I do in mathematics. (VI-5)
3. My father expects me to do well in mathematics. (VI-7)
4. My father has encouraged me to take all the mathematics I can. (VI-9)
5. My father has made me feel I could be good in mathematics. (VI-13)
6. My father thinks mathematics is important to my future. (VI-15)
7. My father has always been interested in my progress in mathematics. (VI-17)
8. My father has made me feel that I have the ability to go on in mathematics. (VI-21)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.80	.89
Grade 12	.92	.91

VI. D. Mother's Encouragement in Mathematics

1. My mother thinks advanced mathematics is a waste of time for me. (VI-4)
2. My mother has not seemed to care how well I do in mathematics. (VI-6)
3. My mother expects me to do well in mathematics. (VI-8)
4. My mother has encouraged me to take all the mathematics I can. (VI-10)
5. My mother has made me feel I could be good in mathematics. (VI-14)
6. My mother thinks mathematics is important to my future. (VI-16)
7. My mother has always been interested in my progress in mathematics. (VI-18)
8. My mother has made me feel that I have the ability to go on in mathematics. (VI-22)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.90	.88
Grade 12	.91	.88

VI.EF- Parents Stereotyping of Mathematics

1. My father thinks mathematics is more for males than for females. (VI-1)
2. My mother thinks mathematics is more for males than for females. (VI-2)

VI.G. Parents Helping with Homework

Who has helped you more with your mathematics homework? (VI-23)

A. Your father
B. Your mother
C. Your father and mother about equally
D. Neither of your parents has helped you

VII.J. Parents' Educational Expectations for Offspring

1. What is the highest level of education your father expects you to complete? (VI-27)

    A. High school
    B. Vocational, trade or technical school
    C. Two-year college
    D. Four-year college or university
    E. Graduate or professional school after college
    F. I don't know.

2. What is the highest level of education your mother expects you to complete? (VI-28)

    A. High school
    B. Vocational, trade or technical school
    C. Two-year college
    D. Four-year college or university
    E. Graduate or professional school after college
    F. I don't know.

VI.K. Family Status

1. With which adult or adults do you live? (VIII-31)

    A. Just your father
    B. Just your mother
    C. Both your parents (or guardians)
    D. Other

2. If you live with only one parent, do you see your OTHER parent often? (VIII-32)

    A. Yes
    B. No
    C. I live with both parents (or guardians)

VII.A. Peer Influence

1. If I got a high grade on a mathematics test, I would not mind if my friends knew it. (VIII-4)
2. My friends think mathematics is a waste of time. (VIII-5)
3. I do not like to appear too smart in mathematics. (VIII-6)
4. My friends look down on people who get good grades in mathematics. (VIII-9)
5. If I got good grades in mathematics, I would try to hide it. (VIII-12)
6. I would NOT want someone who is good in mathematics as my best friend. (VIII-14)
7. There are times when I feel I should play "dumb" in mathematics. (VIII-17)
8. I would like my friends to think I am smart in mathematics. (VIII-22)
9. People would like me less if I were a really good mathematics student. (VIII-26)
10. Many of my friends are good in mathematics. (VIII-27)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.85	.83
Grade 12	.88	.81

VII.B. Peer Stereotyping of Mathematics

1. The boys among my friends think mathematics is more for males than for females. (VIII-1)
2. The girls among my friends think mathematics is more for males than for females. (VIII-15)

VII.C. Counselor Encouragement to Take More Mathematics

Which one of the following statements best describes your experience with a school counselor? The counselor (VIII-35) -

A. strongly encouraged me to take more mathematics than was required to graduate.

B. encouraged me to take more mathematics than was required to graduate.

C. did not care if I took more mathematics than was required to graduate.

D. discouraged me from taking more mathematics than was required to graduate.

E. strongly discouraged me from taking more mathematics than was required.

F. has never counseled me about mathematics.

VII.D. Teacher Encouragement in Mathematics

1. My mathematics teachers have NOT been interested in my progress in mathematics. (VIII-2)
2. My mathematics teachers have expected me to do well in mathematics. (VIII-3)
3. My mathematics teachers have discouraged me from taking more mathematics.((VIII-7)
4. Mathematics teachers have made me feel that I have the ability to go on in mathematics. (VIII-10)
5. My mathematics teachers have made me feel I could be good in mathematics. (VIII-18)
6. My mathematics teachers have been willing to give me individual help (if I needed it). (VIII-21)
7. My mathematics teachers think advanced mathematics is a waste of time for me. (VIII-24)
8. My mathematics teachers have encouraged me to take all the mathematics I can. (VIII-29)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.87	.87
Grade 12	.90	.87

VII.E. Teacher Stereotyping of Mathematics

1. Mathematics teachers think mathematics is more for males than for females. (VIII-28)

VII.F. Teacher Differential Treatment

1. Mathematics teachers treat the girls the same as the boys in mathematics. (VIII-8)
2. Mathematics teachers expect girls to do as well as boys in mathematics. (VIII-11)
3. Mathematics teachers usually call on girls in class as much as boys. (VIII-13)
4. Mathematics teachers encourage girls as much as boys to do well in mathematics. (VIII-16)
5. Mathematics teachers expect boys to do better in mathematics than girls. (VIII-19)
6. Mathematics teachers usually encourage boys more than girls to do well in mathematics. (VIII-20)
7. Mathematics teachers enjoy teaching boys more than girls. (VIII-23)
8. Mathematics teachers usually call on boys in class more than girls. (VIII-25)
9. Mathematics teachers enjoy teaching girls as much as boys. (VIII-30)
10. Mathematics teachers think mathematics is more for males than for females. (VIII-28)

Hoyt Reliability Coefficients

	Male	Female
Age 13	.79	.77
Grade 12	.82	.76

VII.G. Sibling Role Models

1. Do you have an older brother who is good in mathematics? (VIII-33)
   - A. I have an older brother who IS good in mathematics.
   - B. I have an older brother who is NOT good in mathematics or I do not have an older brother. (VIII-33)
2. Do you have an older sister who is good in mathematics? (VIII-34)
   - A. I have an older sister who IS good in mathematics.
   - B. I have an older sister who is NOT good in mathematics or I do not have an older sister.

VIII.A. Mathematics Participation--Grade 12

When answering the questions on this page, if you are presently enrolled in a course that is named, answer "Yes" even though you have not yet completed that course. (II-1-13)

1. Have you completed a course in General Mathematics? Yes Np
2. Have you completed a course in Accounting or Business Mathematics? Yes No
3. Have you completed a course in Consumer Mathematics? Yes No
4. Have you completed a course in Pre-Algebra? Yes No
5. Have you completed a course in Algebra I? Yes No
6. Have you completed a course in Geometry? Yes No
7. Have you completed a course in Algebra II? Yes No
8. Have you completed a course in Trigonometry or a course in which Trigonometry was a major part? Yes No
9. Have you completed a course in Probability or Statistics? Yes No
10. Have you completed a course in Computer Programming? Yes No
11. Have you completed a course in Pre-Calculus? (e.g., advanced or senior mathematics, analytical geometry, elementary functions, advanced or college algebra, mathematics analysis) Yes No
12. Have you completed a course in Calculus? Yes No
13. Did you take Algebra I while you were in the eighth grade? Yes No

VIII.B. Type of School Program--Grade 12

How would you classify the primary emphasis of your high school courses? (II-14)

A. General
B. Vocational, technical or trade
C. College preparatory

VIII.C. Grade in Mathematics

Which one of the following best describes the grades you have gotten in mathematics? (II-2)--Age 13; (II-16)--Grade 12

A. Excellent or A or (90%-100%)
B. Good or B or (80%-89%)
C. Average or C or (70%-79%)
D. Fair or D or (60%-69%)
E. Poor or Failing or F or (Below 60%)

VIII. D. Algebra in Eighth Grade

1. Did you take Algebra while you were in the Eighth grade?

X. SES, Parental Education and Parental Occupations

1. In which group of careers does your father's occupation belong? Use the same list you just used on number 16 and mark the letter of the group on your answer sheet. You may not find your father's exact career listed, but mark the one group in which you think it would fall. (X-17)

2. In which group of careers does your mother's occupation belong? Use the same list you just used on numbers 16 and 17 and mark the letter of the group on your answer sheet. You may not find your mother's exact career listed, but mark the one group in which you think it would fall. (X-18)

3. Which one of the following best describes the highest level of education your father completed? (X-19)

   A. Did not graduate from high school
   B. Graduated from high school
   C. Completed one to three years of study after high school
   D. Graduated from a four-year college or university
   E. Attended a graduate or professional school after college
   F. I don't know.

4. Which one of the following best describes the highest level of education your mother completed? (X-20)

   A. Did not graduate from high school
   B. Graduated from high school
   C. Completed one to three years of study after high school
   D. Graduated from a four-year college or university
   E. Attended a graduate or professional school after college
   F. I don't know.

X. SES, Parental Education and Parental Occupations (Cont'd.)

Do you have the following items in your home? (X-21-31)

A.	A specific place for study	Yes	No
B.	Daily newspaper	Yes	No
C.	Dictionary	Yes	No
D.	Encyclopedia or other reference books	Yes	No
E.	Magazines	Yes	No
F.	Record player	Yes	No
G.	Tape recorder or cassette player	Yes	No
H.	Color television	Yes	No
I.	Typewriter	Yes	No
J.	Electric dishwasher	Yes	No
K.	Two or more cars or trucks that run	Yes	No

APPENDIX C
SOURCE DOCUMENTATION

COGNITIVE ITEMS

Test Section IV--Computation

Items from the Stanford Achievement Test, Form A, Advanced. Harcourt, Brace, Javanovich, Inc., 1972. Test 4, Mathematics Computation, Part B.

The items, in the order they appear in the survey booklet are: 20, 25, 26, 27, 30, 31, 34, 37, 38, 39, 41, 42, 44, 33

Test Section V--Problem Solving

Items from the Metropolitan Achievement Tests, Advanced, Form F. Harcourt, Brace, Jananovich, Inc., 1970. Test 7, Mathematics Problem Solving.

The items, in the order they appear in the survey booklet are: 1, 4, 9, 12, 21, 22, 25, 26, 27, 29.

Items from the Metropolitan Achievement Tests, Form BM. Harcourt, Brace, Jananovich, Inc., 1963. Test 9, Mathematical Analysis and Problem Solving.

The last two items of these final four in the Problem Solving section were for the grade 12 sample only: 3, 7, 10, 26.

Test Section VII--Algebra

Items from the Cooperative Mathematics Tests, Form A, Algebra I. Educational Testing Service, 1962.

The items, in the order they appear in the survey booklet are: 8, 20, 5, 13, 32, 2*, 18, 21, 22, 9, 16, 29, 36, 30, 31, 34

Test Section IX--Space Relations

Items from the Revised Minnesota Paper Form Board, Series AA. The Psychological Corporation, 1969.

The items, in the order they appear in the survey booklet are: 4, 6, 9, 18, 63, 27, 30, 31, 32, 37, 44, 45, 51, 49, 50.

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*Only the first six algebra items were administered to the thirteen-year-old sample.

ATTITUDE ITEMS

Sources are indicated by variable and item number as they appear on pages 22-39 of this report.

Fennema, Elizabeth and Julia A. Sherman, "Fennema-Sherman Mathematics Attitudes Scales: Instruments Designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males." Journal Supplement Abstract Service of the American Psychological Association, MS 1225, 1976.	I.A.-6, I.B.-3, I.B.-7 III.A.-7,8, III.B.-1, III.B.-7,8, IV.-2,3,4, VI.B.-1, VI.B.-7, VI.B-1 VI. B.-7, VII.A.-5,9, VII.D.-1,4,7,8
Dutton, W. "Prospective Elementary School Teachers Understanding of Arithmetic Concepts." *Journal of Educational Research*, 58 (8), 1965.	III.C.-1
Sandman, Richard. "The Development, Validation and Application of Multidimensional Mathematics Attitude Instrument." Ph.D. dissertation, University of Minnesota, 1972.	III.A.-2, III.C.-8
Wilson, J.W., Cahen. L.S. and Begle, E.G. (Eds.) *Z-Population Test Batteries* (NLSMA Report No. 3) Stanford, CA: School of Mathematics Study Group, 1958.	III.A.-6
Rocky Mountain Educational Laborartory, Inc. "Occupational Educational Program--Image of the World of Work."	I.A.-6
Stright, Virginia. "A study of Attitudes Toward Arithmetic of Students and Teachers in the Third, Fourth and Sixth Grades." *Arithmetic Teacher* 7 (6), 1960.	IV.-9

APPENDIX D

REVISED ATTITUDE SCALES

Attitude Toward Mathematics

1. Mathematics is easier for me than it is for most people. (I-1)*
2. I am not very good at working mathematics problems. (I-18)
3. Mathematics does not scare me at all. (I-19)
4. I dread mathematics class. (I-24)
5. Mathematics teachers make me more nervous than other teachers. (I-25)
6. I have never liked mathematics. (I-27)
7. I am confident in mathematics. (I-31)
8. I usually do not worry about mathematics. (I-32)
9. I just cannot understand mathematics. (I-34)
10. I usually feel confident when taking mathematics tests. (I-36)
11. I enjoy mathematics classes. (I-37)
12. I am very proud of my mathematics schoolwork. (I-38)
13. Taking mathematics tests scares me. (III-5)
14. I can get good grades in mathematics. (III-7)
15. I am no good in mathematics. (III-16)
16. Working mathematics problems makes me tense. (III-17)
17. I usually have been at ease during mathematics tests. (III-22)
18. I am usually at ease in mathematics class. (III-27)
19. Doing mathematics problems is usually frustrating. (III-20)

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* Indicates location in survey booklet: Section I, Item 1.

Reliability Coefficients (Alpha)

Grade 12 - .96
Age 13 - .93

Stereotyping of Women

1. If a man and a woman are equally qualified for a job, the man should get hired. (I-3)
2. Just as many women could be good scientists or engineers as men. (I-5)
3. I would never vote for a woman to be president of the United States, even if she were well qualified. (I-7)
4. Men need to know more mathematics than women. (I-8)
5. Girls can do just as well as boys in mathematics. (I-14)
6. Women do not do as well as men in jobs that use a lot of mathematics. (I-17)
7. A college education is more important for boys than for girls. (I-20)
8. Married women should work only if their families need the money. (I-29)
9. Fewer females than males have the logical ability to become mathematicians. (I-30)
10. Men are naturally more able than women in scientific and technical fields. (I-35)
11. Mathematics is more for males than for females. (III-12)
12. If I marry, I want the husband to work and the wife to take care of the home and family. (III-14)
13. A woman can be very successful in a career and still have an interesting social life. (III-24)
14. A wife's professional career is as important as her husband's. (III-29)

Reliability Coefficients (Alpha)

Grade 12 - .88
Age 13 - .86

Parental Encouragement

1. My father has encouraged me to take all the mathematics I can. (VI-9)
2. My mother has encouraged me to take all the mathematics I can. (VI-10)
3. My father has made me feel I could be good in mathematics. (VI-13)
4. My mother has made me feel I could be good in mathematics. (VI-14)
5. My father has always been interested in my progress in mathematics. (VI-17)
6. My mother has always been interested in my progress in mathematics. (VI-18)
7. My father has made me feel that I have the ability to go on in mathematics. (VI-21)
8. My mother has made me feel that I have the ability to go on in mathematics. (VI-22)

Reliability Coefficients (Alpha)

Grade 12 - .89
Age 13 - .86

School Anxiety

1. I am usually at ease in English class. (I-11)
2. English assignments are usually frustrating. (I-15)
3. I am usually at ease in school classes. (I-21)
4. Taking tests in English class scares me. (I-23)
5. Doing English assignments makes me feel tense. (I-28)
6. English class does not scare me at all. (III-15)
7. Schoolwork is usually frustrating. (III-21)
8. I dread English class. (III-25)

Reliability Coefficients (Alpha)

Grade 12 - .87
Age 13 - .80

Teacher Stereotyping

1. Mathematics teachers expect boys to do better in mathematics than girls. (VIII-19)
2. Mathematics teachers usually encourage boys more than girls to do well in mathematics. (VIII-20)
3. Mathematics teachers enjoy teaching boys more than girls. (VIII-23)
4. Mathematics teachers usually call on boys in class more than girls. (VIII-25)
5. Mathematics teachers think mathematics is more for males than for females. (VIII-28)

Reliability Coefficient (Alpha)

Grade 12 - .85
Age 13 - .78

Usefulness

1. I will use mathematics in many ways as an adult. (I-16)
2. I probably will not need mathematics in my future work. (I-22)
3. Knowing mathematics will help me better understand the world about me. (I-39)
4. Mathematics is useful in my daily life. (III-10)
5. Not taking high school mathematics would seriously limit jobs that are available to me. (III-13)
6. Mathematics is important to my future educational plans. (III-20)
7. I cannot see how mathematics will be very useful to me outside of school. (III-23)
8. Knowing mathematics will help me get a good job. (III-31)

Reliability Coefficients (Alpha)

Grade 12 - .86
Age 13 - .78

Teacher Encouragement

1. My mathematics teachers have NOT been interested in my progress in mathematics. (VIII-2)

2. My mathematics teachers have expected me to do well in mathematics. (VIII-3)

3. My mathematics teachers have been willing to give me individual help (if I needed it). (VIII-21)

4. My mathematics teachers have encouraged me to take all the mathematics I can. (VIII-29)

Reliability Coefficient (Alpha)

Grade 12 - .70
Age 13 - .63

Teacher Differential Treatment

1. Mathematics teachers expect girls to do as well as boys in mathematics. (VIII-11)

2. Mathematics teachers usually call on girls in class as much as boys. (VIII-13)

3. Mathematics teachers encourage girls as much as boys to do well in mathematics. (VIII-16)

4. Mathematics teachers enjoy teaching girls as much as boys. (VIII-30)

Reliability Coefficient (Alpha)

Grade 12 - .71
Age 13 - .71

Father as a Role Model

1. My father likes mathematics. (VI-11)

2. My father is good in mathematics. (VI-19)

3. How often does your father use mathematics?
   A. Often
   B. Sometimes
   D. Rarely
   E. Never (VI-25)

Reliability Coefficient (Alpha)

Grade 12 - .75
Age 13 - .66

Mother as a Role Model

1. My mother likes mathematics. (VI-12)

2. My mother is good in mathematics. (VI-20)

3. How often does your mother use mathematics?
   A. Often
   B. Sometimes
   C. Rarely
   D. Never (VI-26)

Reliability Coefficient (Alpha)

Grade 12 - .70
Age 13 - .61

APPENDIX E

Supplementary Tables

TABLE A

ATTITUDES AND INTERESTS OF STUDENTS
FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978.
MEANS BY SEX AND AGE LEVEL.

		Grade 12				Age 13			
Variable		National	Male	Female	Difference	National	Male	Female	Difference
I. Sex Role Stereotyping									
A. General Sex Role Stereotyping	$\bar{x}$	72.35	63.37	80.44	-17.07**	69.09	62.22	75.95	-13.73**
	S.E.	.84	.95	.64	1.15	.67	.81	.80	1.14
	n	1786	868	918		1451	723	728	
B. Mathematics as a Male Domain	$\bar{x}$	79.24	72.91	84.94	-12.03**	76.42	69.70	81.13	-11.43**
	S.E.	.69	.89	.76	1.17	.74	.84	.76	1.13
	n	1787	869	918		1450	723	727	
C. Men's Attitudes Towards Women Successful in Mathematics	$\bar{x}$	68.83	66.75	70.71	- 3.96**	63.69	62.15	65.23	- 3.08**
	S.E.	.62	.83	.68	1.07	.73	.69	.99	1.21
	n	1786	868	918		1451	723	728	
II. Career Plans									
A. Mathematics Preparation Required for a Job	$\bar{x}$	3.00	3.10	2.91	.19*	3.16	3.21	3.12	.09
	S.E.	.05	.07	.06	.09	.04	.06	.07	.09
	n	1736	840	896		1315	654	661	
B. Factors Affecting Career Choice - Job Done by Opposite Sex	$\bar{x}$	46.69	40.71	51.95	-11.24**	47.95	45.47	50.37	- 4.90**
	S.E.	.59	.75	1.00	1.25	.81	1.10	1.17	1.61
	n	1724	832	892		1292	639	653	
C. Job Requires Use of Mathematics	$\bar{x}$	54.10	55.57	52.82	2.75	57.80	58.18	57.43	.75
	S.E.	1.07	1.18	1.60	1.99	1.08	1.52	1.26	1.97
	n	1725	831	894		1291	640	651	

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*$p<.05$
**$p<.01$
(Table continued on next page.)

TABLE A (CONT.)

Variable		Grade 12				Age 13			
		National	Male	Female	Difference	National	Male	Female	Difference
III. Mathematics and Oneself									
A. Confidence in Mathematics	$\bar{x}$	59.04	62.64	55.78	6.86**	63.67	65.87	61.48	4.39**
	S.E.	1.02	1.14	1.22	1.67	.89	.74	1.32	1.51
	n	1786	868	918		1450	723	727	
B. Anxiety in Mathematics	$\bar{x}$	58.50	61.59	55.73	5.86**	62.29	63.93	60.65	3.28*
	S.E.	.99	.99	1.38	1.70	.94	.94	1.34	1.64
	n	1785	867	918		1450	723	727	
C. Anxiety in English	$\bar{x}$	62.81	58.74	66.48	-7.74**	58.09	55.19	60.99	-5.80**
	S.E.	.89	1.39	1.01	1.71	.73	.94	.85	1.27
	n	1786	868	918		1450	723	727	
D. Anxiety in School	$\bar{x}$	65.27	64.72	65.76	-1.04	60.15	60.23	60.07	.16
	S.E.	.56	.64	.78	1.01	.64	.73	.86	1.13
	n	1786	868	918		1450	723	727	
E. Enjoyment of Mathematics	$\bar{x}$	52.43	52.70	52.18	.52	54.21	54.96	53.46	1.50
	S.E.	.83	1.27	.90	1.56	1.11	1.19	1.39	1.83
	n	1785	867	918		1450	723	727	
F. Locus of Control in Mathematics	$\bar{x}$	69.02	72.65	65.75	6.90**	66.41	67.59	65.24	2.35
	S.E.	.90	1.17	1.48	1.48	.82	1.49	1.29	1.97
	n	1781	865	916		1441	718	723	
G. Mathematics and Oneself Composite	$\bar{x}$	58.03	60.39	55.81	4.58**	61.56	63.08	60.04	3.04*
	S.E.	.72	.97	1.12	1.48	.83	.81	1.17	1.42
	n	1785	867	918		1450	723	727	
IV. Usefullness of Mathematics to the Individual	$\bar{x}$	73.07	74.12	72.12	2.00	76.26	76.69	75.83	.86
	S.E.	.66	.88	.80	1.19	.59	.61	.72	.94
	n	1786	868	918		1451	723	728	

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*p<.05

(Table continued on next page.)

TABLE A (CONT.)

Variable		Grade 12				Age 13			
		National	Male	Female	Difference	National	Male	Female	Difference
V. Academic Plans									
A. Educational Aspirations	$\bar{x}$	3.41	3.36	3.45	- .09	3.23	3.11	3.35	- .24*
	S.E.	.05	.08	.05	.10	.05	.06	.06	.09
	n	1786	868	918		1451	723	728	
VI. Parental Influences									
A. Father as a Role Model	$\bar{x}$	70.26	71.45	69.18	2.27	72.54	72.14	72.94	- .80
	S.E.	.94	1.19	1.09	1.61	.82	1.01	.96	1.39
	n	1763	855	908		1419	704	715	
B. Mother as a Role Model	$\bar{x}$	64.53	63.73	65.26	-1.53	67.63	68.20	67.07	1.13
	S.E.	.69	1.28	.66	1.43	.61	.75	.85	1.13
	n	1766	856	910		1419	703	716	
C. Father's Encouragement	$\bar{x}$	68.29	69.98	66.78	3.20*	74.62	74.73	74.51	.22
	S.E.	.73	1.04	.66	1.23	.51	.74	.54	.92
	n	1764	855	909		1418	703	715	
D. Mother's Encouragement	$\bar{x}$	71.37	71.94	70.85	1.09	77.64	77.31	77.96	- .65
	S.E.	.79	.92	.78	1.21	.48	.67	.58	.89
	n	1768	855	913		1418	702	716	
E. Fathers Stereotyping of Mathematics	$\bar{x}$	70.36	64.65	75.48	-10.83**	70.42	67.04	73.75	-6.71**
	S.E.	.79	1.23	.94	1.55	.87	1.10	1.01	1.49
	n	1763	853	910		1417	703	714	
F. Mothers Stereotyping of Mathematics	$\bar{x}$	71.77	65.88	77.33	-11.75**	72.43	68.28	76.51	-8.23**
	S.E.	.79	1.21	.87	1.49	.83	1.05	1.21	1.60
	n	1764	853	911		1417	701	716	
G. Father's Educational Expectations	$\bar{x}$	4.42	4.30	4.54	- .24	5.11	4.72	5.49	- .77**
	S.E.	.10	.09	.18	.20	.10	.12	.12	.17
	n	1799	863	916		1427	709	718	

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*p<.05
**p<.01
(Table continued on next page.)

TABLE A (CONT.)

Variable		Grade 12 National	Grade 12 Male	Grade 12 Female	Grade 12 Difference	Age 13 National	Age 13 Male	Age 13 Female	Age 13 Difference
H. Mother's Educational Expectations	$\bar{x}$	4.09	4.25	3.94	.31	4.77	4.56	4.97	- .41*
	S.E.	.07	.14	.12	.19	.08	.11	.11	.15
	n	1779	863	916		1427	709	718	
VII. Influences of Significant Others									
A. Peer Influence	$\bar{x}$	71.59	69.92	73.07	-3.15**	68.80	68.19	69.40	-1.21
	S.E.	.54	.60	.63	.87	.58	.67	.76	1.01
	n	1767	855	912		1419	704	715	
B. Boys Stereotyping of Mathematics	$\bar{x}$	65.03	63.10	66.73	-3.63**	59.90	57.97	61.83	-3.86*
	S.E.	.84	1.04	1.14	1.54	.78	1.16	.98	1.52
	n	1764	852	911		1412	703	709	
C. Girls Stereotyping of Mathematics	$\bar{x}$	72.22	66.53	77.27	-10.74**	68.16	62.87	73.32	-10.45**
	S.E.	.79	1.20	.75	1.42	.93	1.09	1.19	1.61
	n	1762	853	909		1411	697	714	
D. Counselor Encouragement	$\bar{x}$	73.74	73,54	73.94	- .40	65.45	63.68	67.82	- 4.14
	S.E.	1.11	1.66	1.37	2.15	1.38	1.92	2.71	3.32
	n	1053	544	509		566	322	234	
E. Teacher Encouragement	$\bar{x}$	67.31	66.54	67.99	-1.45	68.65	67.68	70.01	- 2.33*
	S.E.	.75	.80	.93	1.23	.63	.75	.80	1.10
	n	1767	855	912		1416	702	714	
F. Teacher Stereotyping of Mathematics	$\bar{x}$	75.05	72.71	77.12	-4.41**	72.98	69.43	76.45	- 7.02**
	S.E.	.87	1.32	.68	1.48	.77	.90	1.00	1.35
	n	1762	852	910		1410	696	714	
G. Teacher Differential Treatment	$\bar{x}$	72.89	70.32	75.17	-4.85**	70.82	68.08	73.53	-5.45**
	S.E.	.56	.81	.65	1.04	.66	.80	.80	1.13
	n	1766	855	911		1418	703	715	

(Table continued on next page.)

TABLE A (CONT.)

Variable		Grade 12				Age 13			
		National	Male	Female	Difference	National	Male	Female	Difference
VIII. School Experience									
A. Grades in Mathematics	$\overline{x}$	2.67	2.65	2.69	- .04	2.72	2.66	2.78	.12
	S.E.	.04	.05	.04	.06	.04	.05	.06	.08
	n	1786	868	918		1451	723	728	
IX. Background Variables									
A. Fathers Education	$\overline{x}$	3.22	3.23	3.20	.03	4.15	4.05	4.25	- .20
	S.E.	.08	.12	.14	.18	.12	.15	.14	.20
	n	1736	840	896		1315	654	661	
B. Mothers Education	$\overline{x}$	2.77	2.80	2.74	.06	3.71	3.72	3.69	.03
	S.E.	.09	.12	.14	.18	.11	.15	.13	.19
	n	1736	840	896		1315	654	661	
C. Socioeconomic Status Index	$\overline{x}$	73.99	75.44	72.72	2.72	73.03	73.14	72.92	.22
	S.E.	.90	.78	1.15	1.39	.82	.84	.89	1.22
	n	1684	815	869		1294	641	653	

$^{*}p<.05$
$^{**}p<.01$

TABLE B

ASPIRATIONS, CURRENT ENVIRONMENT AND BACKGROUND OF STUDENTS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. PERCENTAGES OF RESPONSES BY SEX AND AGE LEVEL.

		Grade 12				Age 13			
Variable		National	Male	Female	Difference	National	Male	Female	Difference
I. Career Aspirations									
1. Artists and Entertainers	%	11.97	11.06	12.78	-1.72	14.47	13.61	15.32	-1.71
	S.E.	1.13	2.27	1.40	2.67	1.05	1.18	1.89	2.23
	n	1736	840	896		1315	654	661	
2. Clerical, Technical and Service Personnel	%	20.16	12.18	27.23	-15.05**	13.07	11.32	14.80	-3.48
	S.E.	1.23	1.84	2.02	2.66	1.12	1.56	1.43	2.12
3. Executives	%	1.91	2.85	1.07	1.78**	4.05	5.33	2.79	2.54
	S.E.	.36	.57	.34	.66	.66	1.07	.71	1.28
4. Homemaker	%	1.17	.72	1.56	- .84	3.34	2.23	4.44	-2.21*
	S.E.	.37	.54	.54	.76	.60	.64	.90	1.10
5. Management and Marketing Personnel	%	6.62	5.93	7.23	-1.30	5.52	7.34	3.72	3.62*
	S.E.	.62	1.16	1.27	1.72		1.15	.97	1.50
6. Professionals	%	36.21	35.35	36.96	1.61	30.63	20.68	40.46	-19.78**
	S.E.	1.90	3.25	1.96	3.62	1.43	1.70	2.23	2.80
7. Semi-Skilled Workers	%	3.23	4.14	2.42	1.72	6.80	10.45	3.19	7.26**
	S.E.	.57	.95	.67	1.16	.81	1.30	.76	1.51
8. Skilled Workers	%	11.92	21.89	3.09	18.80**	10.29	17.00	3.65	13.35**
	S.E.	1.52	2.83	.60	2.83	1.05	1.66	.69	1.80

*p<.05
**p<.01

(This Table is continued on next Page.)

TABLE B (CONT.)

		Grade 12				Age 13			
Variable		National	Male	Female	Difference	National	Male	Female	Difference
II. Parental Influences									
A. Who helped more with mathematics homework?									
1. Father	%	24.56	25.47	23.75	1.72	25.11	24.44	25.78	-1.34
	S.E.	1.55	2.47	2.06	3.21	1.60	2.08	2.46	3.22
	Total n	1779	863	916		1427	709	718	
2. Mother	%	24.06	23.71	24.38	- .67	35.85	36.07	35.63	.44
	S.E.	1.59	2.26	1.99	3.01	1.27	1.86	1.94	2.69
3. Both Equally	%	15.12	17.52	12.97	4.55	22.76	23.62	21.91	1.71
	S.E.	1.63	2.21	1.93	2.92	1.47	1.95	1.86	2.69
4. Neither Helped	%	35.36	32.20	38.19	-5.99	14.94	13.66	16.21	-2.55
	S.E.	2.11	1.83	2.98	3.50	1.33	1.23	1.87	2.24
B. Who uses more math in your home?									
1. Mother	%	29.84	25.33	33.87	-8.54*	28.08	28.88	27.28	1.60
	S.E.	2.00	2.49	2.78	3.73	1.43	1.83	1.99	2.70
	n	1779	863	916		1427	709	718	
2. Father	%	39.86	46.47	33.94	12.53*	38.57	42.24	34.93	7.31*
	S.E.	1.91	2.41	2.50	3.47	1.44	2.20	1.97	2.95
3. Both the same	%	29.43	27.21	31.42	-4.21	31.91	26.78	37.00	-10.22**
	S.E.	1.63	2.64	1.50	2.21	1.41	1.87	1.98	2.72

*$p<.05$
**$p<.01$
(This Table is continued on the next page.)

TABLE B (CONT.)

		Grade 12				Age 13			
Variable		National	Male	Female	Difference	National	Male	Female	Difference
C. Which adult do you live with?									
1. Just Father	%	2.61	3.48	1.83	1.65	2.01	1.96	2.05	- .09
	S.E.	.52	.84	.55	1.00	.40	.55	.55	.78
	n	1769	857	912		1423	707	716	
2. Just Mother	%	18.74	14.96	22.08	- 7.12*	16.49	14.58	18.39	-3.81
	S.E.	1.65	2.04	2.44	3.18	1.22	1.37	1.97	2.40
3. Both Parents	%	73.90	77.92	70.34	7.58	76.64	77.31	75.99	1.32
	S.E.	2.20	1.87	3.31	3.80	1.56	1.67	1.99	2.60
4. Other	%	2.91	1.64	4.03	- 2.39	3.38	4.09	2.67	1.42
	S.E.	.56	.62	.98	1.15	.60	1.05	.84	1.34
D. If you live with only one parent, do you see the other often?									
1. Yes	%	9.43	10.22	8.72	1.50	11.00	11.90	10.11	1.79
	S.E.	1.04	1.79	1.59	2.39	1.00	1.29	1.76	2.18
	n	1769	857	912		1423	707	716	
2. No	%	15.70	11.59	19.34	- 7.75*	14.36	14.23	14.49	- .26
	S.E.	1.98	1.77	2.95	3.48	1.31	1.70	1.28	2.13
3. I live with both parents.	%	71.86	75.36	68.77	6.59	72.70	71.21	74.19	-2.98
	S.E.	2.20	2.19	3.41	4.05	1.72	1.95	2.31	3.02

*p<.05
**p<.01

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TABLE B (CONT.)

		Grade 12				Age 13			
Variable		National	Male	Female	Difference	National	Male	Female	Difference
III. Influence of Significant Others									
A. Do you have an older brother good in mathematics?									
1. Yes	%	36.80	33.29	39.90	- 6.61	38.80	37.93	39.67	-1.74
	S.E	2.13	2.75	2.42	3.66	1.52	2.08	1.98	2.87
Total	n	1769	857	912		1423	707	716	
2. No	%	58.01	61.76	54.69	7.07*	54.30	52.78	55.81	-3.03
	S.E	2.02	2.72	2.08	3.42	1.66	2.03	2.11	2.93
B. Do you have an older sister good in mathematics?									
1. Yes	%	35.68	37.69	33.90	3.79	44.28	43.72	44.83	-1.11
	S.E	2.42	3.21	2.41	4.01	1.76	2.25	2.05	3.04
Total	n	1769	857	912		1423	707	716	
2. No	%	58.73	56.19	60.98	-4.79	49.60	49.10	50.10	-1.00
	S.E	2.25	3.24	2.11	3.87	1.97	2.59	2.01	3.28

*p<.05
**p<.01

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TABLE B (CONT.)

Variable		Grade 12				Age 13			
		National	Male	Female	Difference	National	Male	Female	Difference
IV. School Experience									
A. Classify emphasis of high school courses									
1. General	%	35.88	32.67	38.76	-6.09	(Question not asked of 13 year olds.)			
	S.E.	2.65	3.09	3.40	4.59				
Total	n	1786	868	918					
2. Vocational, Technical or Trade	%	20.32	22.37	18.47	3.90				
	S.E.	2.45	2.94	2.55	3.89				
3. College Preparatory	%	43.35	44.33	42.47	1.86				
	S.E.	2.47	3.14	2.82	3.56				
B. Did you take Algebra in the 8th grade?									
1. Yes	%	21.74	24.94	18.86	6.08*	18.70	14.77	22.62	-7.85
	S.E.	1.72	2.50	2.11	2.88	1.93	1.89	2.54	3.17*
Total	n	1786	868	918		1451	723	728	
2. No	%	77.91	74.37	81.81	-7.44*	60.71	62.60	58.82	3.78
	S.E.	1.69	2.58	2.11	3.33	2.33	2.42	2.91	3.78

*p<.05
**p<.01

(This Table is continued on the next page).

TABLE B (CONT.)

Variable		Grade 12 National	Grade 12 Male	Grade 12 Female	Grade 12 Difference	Age 13 National	Age 13 Male	Age 13 Female	Age 13 Difference
V. Background Variables									
A. Fathers occupation. Which group of careers does your father belong in?									
1. Artists and Entertainers	%	1.17	1.20	1.13	.07	1.24	1.66	.83	.83
	S.E.	.48	.88	.42	.97	.36	.52	.38	.64
	Total n	1736	840	896		1315	654	661	
2. Clerical, Technical and Service Personnel	%	10.79	9.29	12.11	-2.82	12.46	12.46	12.46	0.00
	S.E.	1.84	2.14	2.01	2.93	1.21	1.51	1.85	2.39
3. Executives	%	6.92	7.61	6.30	1.31	7.94	7.85	8.02	- .17
	S.E.	.65	1.01	1.01	1.43	.95	1.22	1.31	1.79
4. Homemaker	%	1.24	1.38	1.12	.26	1.86	1.52	2.20	- .68
	S.E.	.45	.64	.63	.90	.57	.53	.85	1.00
5. Management and Marketing Personnel	%	14.07	15.72	12.60	3.12	12.68	12.45	12.91	- .46
	S.E.	1.30	1.50	1.43	2.07	1.05	1.27	1.68	2.11
6. Professionals	%	14.27	17.33	11.57	5.76	8.93	8.70	9.17	- .47
	S.E.	1.94	2.62	1.79	3.03	1.05	1.07	1.27	1.66
7. Semi-skilled Workers	%	21.42	19.39	23.22	-3.83	21.59	23.21	20.00	3.21
	S.E.	2.09	2.98	2.05	3.62	1.70	2.42	1.83	3.03
8. Skilled Workers	%	23.76	22.82	24.59	-1.77	22.30	22.02	22.57	- .55
	S.E.	1.93	2.12	3.02	3.69	1.49	1.48	2.41	2.83

(This Table is continued on the next page.)

TABLE B (CONT.)

Variable		Grade 12				Age 13			
		National	Male	Female	Difference	National	Male	Female	Difference
B. Mothers Occupation Which group of careers does your mother belong in?									
1. Artists and Entertainers	%	.99	1.13	.87	.26	2.41	3.16	1.67	1.49
	S.E.	.26	.33	.42	.53	.50	.93	.59	1.10
	Total n	1736	840	896		1315	654	661	
2. Clerical, Technical or Service Personnel	%	23.17	22.98	23.34	- .36	18.58	18.03	19.13	-1.10
	S.E.	1.89	2.17	2.39	3.23	.95	1.48	1.41	2.04
3. Executives	%	2.15	2.33	1.99	.34	3.92	5.14	2.71	2.43
	S.E.	.76	1.03	1.06	1.48	.73	1.19	.66	1.36
4. Homemaker	%	30.48	28.33	32.39	-4.06	27.56	25.39	29.72	-4.33
	S.E.	1.74	2.01	2.91	3.54	1.28	1.58	1.97	2.53
5. Management and Marketing Personnel	%	5.54	6.85	4.38	2.47	6.68	6.09	7.27	-1.18
	S.E.	.85	1.11	1.07	1.54	.92	1.03	1.31	.74
6. Professionals	%	13.14	12.06	14.10	-2.04	11.11	10.53	11.68	-1.15
	S.E.	1.26	1.31	1.91	2.32	.94	1.03	1.49	1.81
7. Semi-Skilled Workers	%	15.49	14.67	16.22	-1.55	13.19	11.20	15.15	-3.95
	S.E.	1.65	1.80	2.21	2.85	1.34	1.68	1.71	2.40
8. Skilled Workers	%	1.61	1.36	1.84	- .48	2.87	3.67	2.07	1.60
	S.E.	.44	.56	.55	.78	.60	.84	.61	1.04

TABLE C

ATITUDES AND INTERESTS OF GRADE 12 STUDENTS WITHIN PARTICIPATION LEVELS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. MEANS BY SEX.

Variable		Level of Participation: Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Sex Role Stereotyping													
A. General Sex Role Stereotyping	$\bar{x}$	61.63	78.27	-16.64**	63.85	81.51	-17.66**	64.34	81.80	-17.46**	65.01	82.26	-17.25**
	S.E.	2.23	.82	2.38	1.88	1.29	2.28	1.89	1.25	2.27	1.59	1.10	1.93
	n	233	266		168	224		163	167		302	259	
B. Mathematics as a male domain	$\bar{x}$	70.09	82.40	-12.31**	75.00	84.85	- 9.85**	73.76	87.64	-13.88**	74.58	88.37	-13.79
	S.E.	1.72	1.30	2.16	1.64	.95	1.90	1.83	1.03	2.10	1.31	1.03	1.67
	n	233	266		168	224		163	167		302	259	
C. Men's attitudes towards women successful in mathematics	$\bar{x}$	65.71	69.32	- 3.61	66.40	71.74	- 5.34**	67.37	69.10	- 1.73	68.82	72.98	- 4.16*
	S.E.	1.73	1.13	2.07	1.44	1.18	1.86	1.31	1.24	1.80	1.19	1.54	1.95
	n	233	266		168	224		163	167		302	259	
II. Career Plans													
A. Mathematics preparation required for a job	$\bar{x}$	2.42	2.49	- .07	2.89	2.67	.22	3.67	3.43	.24	4.04	3.75	- .29*
	S.E.	.09	.12	.15	.14	.13	.19	.09	.09	.13	.07	.09	.12
	n	222	259		165	218		157	161		295	256	
B. Factors Affecting Career Choice: Job Done by Opposite Sex	$\bar{x}$	43.01	52.01	- 9.00**	40.82	51.47	-10.65**	37.61	50.92	-13.31**	39.35	53.10	-13.75**
	S.E.	2.12	1.94	2.87	2.27	1.66	2.81	1.79	1.28	2.20	1.12	1.47	1.85
	n	219	258		165	217		154	160		294	255	

*$p<.05$
**$p<.01$

(This Table is continued on the next page.)

TABLE C (CONT.)

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
C. Job requires use of mathematics	$\bar{x}$	49.11	49.41	- .30	53.19	49.57	3.62	57.20	55.13	2.07	66.66	63.03	3.63
	S.E.	2.02	2.72	3.39	2.60	2.34	3.50	1.80	2.14	2.08	1.76	1.60	2.38
	n	217	259		165	217		154	161		295	255	
III. Mathematics and Oneself													
A. Confidence in mathematics	$\bar{x}$	53.07	46.27	6.80**	58.39	53.06	5.33	68.13	61.44	6.69**	78.63	74.82	3.81
	S.E.	1.60	1.48	2.18	2.44	2.69	3.63	1.30	1.96	2.35	1.57	1.61	2.25
	n	233	266		168	224		163	167		302	259	
B. Anxiety in mathematics	$\bar{x}$	55.04	49.06	5.98**	58.76	53.49	5.27	64.50	60.42	4.08	73.27	69.15	4.12
	S.E.	1.85	1.36	2.30	2.40	3.13	3.94	1.57	1.87	2.44	1.77	1.58	2.37
	n	233	266		168	224		163	167		302	259	
C. Anxiety in English	$\bar{x}$	56.25	64.16	-7.91**	58.78	66.51	-7.73*	58.46	70.69	-12.23**	63.07	68.57	-5.50*
	S.E.	2.19	1.46	2.63	2.61	2.17	3.39	2.08	1.30	2.45	1.84	2.04	2.75
	n	233	266		168	224		163	167		302	259	
D. Anxiety in School	$\bar{x}$	60.67	62.02	-1.35	64.44	65.22	- .78	65.87	70.41	- 4.54*	70.90	71.19	- .29
	S.E.	1.44	1.16	1.85	1.82	1.18	2.17	1.35	1.22	1.82	1.42	1.41	2.00
	n	233	266		168	224		163	167		302	259	
E. Enjoyment of mathematics	$\bar{x}$	41.93	44.24	-2.31	47.55	49.08	-1.53	61.30	58.38	2.92	69.56	68.34	1.22
	S.E.	1.78	1.57	2.37	2.75	2.53	3.74	2.30	2.13	3.13	1.71	1.22	2.10
	n	233	266		168	224		163	167		302	259	
F. Locus of Control in mathematics	$\bar{x}$	69.01	66.42	2.59	73.89	61.45	12.44**	74.06	68.60	5.46	73.96	69.16	4.80
	S.E.	2.41	2.20	3.26	3.28	2.14	3.92	2.21	2.20	3.12	2.26	1.45	2.69
	n	232	266		167	223		161	166		301	259	

Level of Participation (spans the Algebra I through Pre-Calculus or Calculus columns)

*p<.05

**p<.01

(This Table is continued on the next page.)

TABLE C (CONT.)

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
G. Mathematics and Oneself Composite	$\bar{x}$	51.83	48.24	3.59	56.51	53.07	3.44	65.78	61.10	4.68*	74.39	71.32	3.07
	S.E.	1.35	1.38	1.93	2.19	2.65	3.44	1.35	1.78	2.23	1.58	1.30	2.05
	n	233	266		168	224		163	167		302	259	
IV. Usefulness of mathematics to the individual	$\bar{x}$	68.53	67.78	.75	71.04	69.62	1.42	78.73	76.77	1.96	83.36	81.35	2.01
	S.E.	1.37	1.77	2.24	2.06	1.59	2.60	1.70	1.61	2.34	1.22	.94	1.54
	n	233	266		168	224		163	167		302	259	
V. Academic Plans													
A. Educational Aspirations	$\bar{x}$	2.54	2.82	.28	3.40	3.49	.09	3.85	3.95	.10	4.23	4.30	- .07
	S.E.	.11	.08	.14	.11	.09	.14	.11	.10	.15	.08	.08	.11
	n	233	266		168	224		163	167		302	259	
VI. Parental Influences													
A. Father as a Role Model	$\bar{x}$	66.34	66.85	- .51	73.65	68.49	5.16	70.86	71.44	- .58	75.79	75.53	2.26
	S.E.	1.76	1.66	2.42	2.02	1.97	2.82	1.50	2.15	2.62	1.49	1.70	2.26
	n	230	264		166	223		161	163		297	256	
B. Mother as a Role Model	$\bar{x}$	67.25	66.07	1.18	62.71	64.40	-1.69	60.67	67.28	- 6.61*	61.19	63.57	-2.38
	S.E.	1.60	1.47	2.17	2.31	1.32	2.66	2.15	1.83	2.82	1.47	1.66	2.22
	n	229	265		167	223		161	163		298	257	
C. Fathers Encouragement	$\bar{x}$	63.55	61.17	2.38	70.13	66.11	4.02	73.18	70.61	2.57	76.68	76.31	.37
	S.E.	1.22	1.42	1.87	1.66	1.36	2.15	2.01	1.92	2.78	1.33	1.82	2.25
	n	230	263		166	224		160	164		298	256	

Level of Participation

*$p<.05$
**$p<.01$
(This Table is continued on the next page.)

TABLE C (CONT.)

Level of Participation

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
D. Mother's Encouragement	$\bar{x}$	66.92	66.45	.47	69.69	69.23	.46	75.16	74.36	.80	80.00	79.84	.16
	S.E.	.98	1.37	1.68	1.44	1.53	2.10	2.63	1.67	3.12	1.23	1.19	1.71
	n	229	265		167	224		160	164		298	258	
E. Fathers Stereotyping of mathematics	$\bar{x}$	60.89	72.88	-11.99**	68.31	76.06	- 7.75**	66.75	76.70	- 9.95**	64.21	79.11	-14.90
	S.E.	2.34	2.18	3.20	2.23	1.79	2.86	3.27	1.37	3.55	1.82	1.40	2.30
	n	230	264		166	223		160	164		296	257	
F. Mothers Stereotyping of mathematics	$\bar{x}$	63.52	74.94	-11.42**	67.79	77.91	-10.12**	65.98	77.98	-12.00**	65.71	80.70	-14.99
	S.E.	2.37	2.31	3.31	2.44	1.48	2.85	3.23	1.88	3.74	1.48	1.73	2.28
	n	229	265		167	223		160	163		296	258	
G. Fathers Educational Expectations	$\bar{x}$	3.98	4.22	- .24	4.30	4.84	- .54	4.57	4.62	- .04	4.67	4.60	.07
	S.E.	.22	.35	.41	.26	.27	.38	.22	.21	.31	.11	.19	.22
	n	182	193		130	169		136	141		258	214	
H. Mothers Educational Expectations	$\bar{x}$	3.85	3.54	.31	4.50	4.03	.47	4.40	4.24	.16	4.52	4.34	.18
	S.E.	.23	.27	.36	.34	.16	.37	.24	.19	.31	.10	.14	.16
	n	190	226		129	189		143	148		273	235	
VII. Influences of Significant Others													
A. Peer Influence	$\bar{x}$	67.46	70.75	- 3.29**	69.02	73.12	- 4.10*	70.73	74.21	- 3.48	74.21	76.79	- 2.58
	S.E.	.99	.74	1.24	1.13	1.20	1.65	1.47	1.52	2.11	1.25	.89	1.53
	n	230	266		168	223		159	163		298	258	

*p<.05
**p<.01
(This Table is continued on the next page.)

TABLE C (CONT.)

Level of Participation

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-calculus or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
B. Boys Stereotyping of Mathematics	$\bar{x}$	66.12	65.67	.45	62.98	68.07	- 5.09	63.68	63.70	- .02	58.48	68.70	-10.22
	S.E.	1.51	2.04	2.54	2.26	2.73	3.54	3.07	3.33	4.53	1.80	2.42	3.02
	n	230	265		168	223		158	162		297	258	
C. Girls Stereotyping of Mathematics	$\bar{x}$	66.64	74.42	- 7.78**	66.54	79.35	-12.81**	66.46	78.64	-12.18**	66.40	78.73	-12.33**
	S.E.	1.26	1.24	1.77	2.54	1.70	3.06	2.25	1.39	2.64	2.06	1.40	2.49
	n	230	265		167	222		158	162		298	258	
D. Counselor Encouragement	$\bar{x}$	65.27	66.59	- 1.32	73.87	75.15	- 1.28	76.17	77.73	- 1.56	82.15	79.89	2.26
	S.E.	4.10	3.19	5.19	3.02	2.10	3.68	2.17	2.74	3.50	1.54	2.08	2.59
	n	131	119		93	121		108	101		212	166	
E. Teacher Encouragement	$\bar{x}$	59.79	61.41	- 1.62	64.59	66.75	- 2.16	70.04	73.63	- 3.59	76.81	79.16	- 2.35
	S.E.	1.34	1.71	2.17	1.19	1.05	1.59	1.74		2.26	1.18	1.15	1.65
	n	230	266		168	223		159	163		298	258	
F. Teacher Stereotyping of Mathematics	$\bar{x}$	70.11	75.65	- 5.54*	73.16	76.67	- 3.51	73.59	78.15	- 4.56	75.31	80.33	- 5.02*
	S.E.	1.79	1.53	2.35	1.99	1.53	2.51	2.41	1.56	2.87	1.74	1.22	2.13
	n	229	265		168	222		159	163		296	258	
G. Teacher Differential treatment	$\bar{x}$	66.51	74.16	- 7.65**	71.78	75.05	- 3.27	71.12	75.55	- 4.43	73.37	77.09	- 3.72
	S.E.	1.19	1.01	1.56	1.13	.94	1.47	1.88	1.61	2.48	1.18	1.09	1.61
	n	230	266		168	222		159	163		298	258	
VIII. School Experience													
A. Grades in Mathematics	$\bar{x}$	2.28	2.34	.06	2.41	2.57	.16	2.84	2.94	.10	3.35	3.42	.07
	S.E.	.09	.05	.11	.08	.10	.12	.06	.07	.09	.06	.06	.08
	n	233	266		168	224		163	167		302	259	

*p<.05

**p<.01

(This table is continued on the next page.)

TABLE C (CONT.)

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus or Calculus		
		Level of Participation											
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
IX. Background Variables													
A. Fathers Education	$\bar{x}$	3.01	3.18	- .17	3.37	3.09	.28	3.44	3.22	.22	3.25	3.35	- .10
	S.E.	.24	.27	.36	.20	.16	.26	.20	.18	.27	.14	.19	.23
	n	222	259		165	218		157	161		295	256	
B. Mothers Education	$\bar{x}$	2.64	2.70	- .06	2.92	2.70	.22	2.83	2.73	.10	2.86	2.81	.05
	S.E.	.19	.25	.31	.22	.23	.32	.18	.13	.22	.12	.09	.15
	n	222	259		165	218		157	161		295	256	
C. Socioeconomic Status Index	$\bar{x}$	72.64	68.75	3.89*	77.16	75.28	1.88	74.97	74.22	.75	77.33	75.56	1.77
	S.E.	1.11	1.38	1.77	1.45	1.27	1.93	1.22	1.51	1.94	.87	1.29	1.56

*p<.05
**p<.01

TABLE D

ASPIRATIONS, CURRENT ENVIRONMENT AND BACKGROUND OF GRADE 12 STUDENTS WITHIN PARTICIPATION LEVEL
FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978.
PERCENTAGES OF RESPONSE BY SEX AND AGE LEVEL.

Variable		Level of Participation: Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus and/or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Career Aspirations													
A. Artists and Entertainers	%	17.67	11.67	6.00	11.74	18.51	- 6.76	7.26	8.30	- 1.05	3.30	8.97	- 5.67*
	S.E.	4.70	2.09	5.14	2.72	3.50	4.43	2.91	2.33	3.73	1.11	2.33	2.58
	Total n	222	259		165	218		157	161		295	256	
B. Clerical, Technical and Service Personnel	%	8.37	38.57	-30.20**	16.81	26.89	-10.09*	11.08	21.42	-10.35*	12.00	10.06	1.94
	S.E.	2.14	3.73	4.30	2.53	3.60	4.40	3.46	3.94	5.24	2.57	2.64	3.68
C. Executives	%	12.06	7.64	1.22	11.76	9.19	.68	13.83	9.80	1.83	8.97	9.59	3.69
	S.E.	3.17	1.51	1.03	3.64	2.26	1.18	4.01	3.08	2.04	1.91	1.92	1.96
D. Homemaker	%	1.69	3.18	- 1.48	0.00	.38	- .38	.53	1.46	- .93	.46	.36	.11
	S.E.	1.46	1.51	2.10	.00	.27	.27	.51	.27	.58	.28	.26	.38
E. Management and Marketing Personnel	%	3.21	5.27	- 2.06	6.66	11.25	- 4.59	9.09	7.22	1.87	6.76	4.87	1.89
	S.E.	1.20	1.77	2.14	2.65	3.17	4.13	2.80	1.49	3.17	1.49	1.63	2.21
F. Professionals	%	13.93	23.27	- 9.34	35.31	31.51	3.81	43.78	48.69	- 4.91	60.40	64.46	- 4.06
	S.E.	3.84	4.09	5.61	4.96	3.39	6.01	4.60	6.23	7.74	3.42	3.62	4.98
G. Semi-Skilled Workers	%	9.61	5.12	4.49	1.12	.58	.54	4.58	.75	3.84	.29	1.26	- .97
	S.E.	2.42	1.75	2.99	.54	.49	.73	2.11	.57	2.19	.22	1.29	1.31
H. Skilled	%	38.77	5.01	33.76**	17.03	3.29	15.74**	13.59	1.53	12.06**	7.47	.19	7.28**
	S.E.	6.03	1.43	6.20	3.95	1.46	4.21	3.59	1.36	3.84	1.78	.19	1.79

*p<.05
**p<.01

(This Table is Continued on the next page.)

TABLE D (CONT.)

Level of Participation

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus and/or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
II. Parental Influences													
A. Who helped more with Mathematics Homework?													
1. Father	%	18.86	15.73	3.13	30.68	29.49	1.19	23.68	24.05	- .37	30.04	30.61	.57
	S.E.	4.23	2.11	4.73	5.75	4.27	7.16	3.11	3.46	4.65	3.17	3.29	4.57
Total n		231	266		168	224		162	165		300	259	
2. Mother	%	36.58	35.05	1.53	21.06	21.33	- .27	18.81	20.56	- 1.75	12.58	10.72	1.86
	S.E.	3.72	3.30	4.97	3.96	3.39	5.21	3.63	3.10	4.77	2.20	2.24	3.14
3. Both Equally	%	16.41	15.87	.54	18.38	9.37	9.01	14.73	12.91	1.82	17.57	13.15	4.42
	S.E.	3.46	3.77	5.12	4.69	2.62	5.37	2.88	2.51	3.82	2.77	2.77	3.92
4. Neither Helped	%	27.11	33.30	- 6.19	28.51	39.79	-11.27	41.76	39.13	2.63	39.44	44.21	- 4.77
	S.E.	3.89	3.92	5.52	4.67	5.70	7.37	3.29	4.32	5.43	3.55	3.48	4.97
B. Who uses more Math in your home?													
1. Mother	%	41.24	40.56	.68	14.32	31.07	-16.75**	25.87	34.28	- 8.39	17.65	25.20	- 7.56
	S.E.	4.70	3.81	6.05	3.23	4.81	5.79	3.69	3.32	4.96	2.78	3.29	4.31
2. Father	%	42.69	31.03	11.66	47.65	36.90	10.74	47.59	37.79	9.80*	48.41	32.73	15.67**
	S.E.	4.26	4.82	6.43	5.80	5.12	7.74	3.48	3.39	4.86	4.32	3.65	5.66
3. Both Equally	%	15.88	28.34	-12.46**	36.10	32.00	4.09	25.00	26.01	- .51	33.69	40.75	- 7.06
	S.E.	2.86	3.70	4.68	5.99	4.82	7.69	3.65	3.68	5.18	3.56	2.36	4.27

*p<.05
**p<.01
(This Table in continued on the next page.)

TABLE D (CONT.)

Level of Participation

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
C. Family Status Which adult do you live with?													
1. Just Father	n	230	266		168	223		160	163		298	258	
	%	4.37	.92	3.46	1.66	2.95	- 1.29	3.79	1.55	2.24	4.50	1.80	2.70
	S.E.	2.15	.39	2.19	1.07	1.79	2.09	1.96	.94	2.17	1.51	.74	1.68
2. Just Mother	%	18.95	31.01	-12.06	12.37	21.10	- 8.73	19.50	14.93	4.57	9.84	11.11	- 1.27
	S.E.	4.49	4.59	6.42	3.62	3.35	4.93	6.37	3.00	7.04	2.40	2.69	3.61
3. Both Parents	%	74.63	61.39	13.24*	80.85	70.75	10.10	72.38	78.32	- 5.94	82.73	82.86	- .13
	S.E.	4.11	4.58	6.15	3.46	4.61	5.76	5.81	3.22	6.64	2.91	3.99	4.94
4. Other	%	.63	4.33	- 3.70	2.82	4.62	- 1.80	1.41	2.53	- 1.11	1.65	2.63	- .99
	S.E.	.29	1.14	1.18	1.81	1.66	2.46	.74	1.67	1.83	1.02	1.83	2.10
D. If you live with only one parent, do you see the other often?													
1. Yes	n	230	266		168	223		160	163		298	258	
	%	13.00	12.26	.74	8.00	6.67	1.33	10.05	9.83	.23	9.40	4.29	5.11
	S.E.	3.28	2.70	4.25	3.55	2.35	4.26	2.53	2.08	3.28	2.85	1.81	3.38
2. No	%	15.05	24.42	- 9.37	8.63	20.79	-12.16*	15.53	10.71	4.82	8.12	12.85	- 4.73
	S.E.	3.26	6.01	6.84	2.49	4.58	5.12	6.20	3.15	6.95	1.86	2.52	3.13
3. I live with both parents	%	70.42	59.72	10.71	79.25	69.46	9.79	71.16	75.44	- 4.29	80.38	80.94	- .55
	S.E.	3.69	5.35	6.50	2.75	4.97	5.68	5.83	4.31	7.25	3.44	3.07	4.61

*p<.05
**p<.01

(This table is continued on the next page.)

TABLE D (CONT.)

Level of Participation

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus and/or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
III. Influences of Significant Others													
A. Do you have an older brother good in mathematics?													
1. Yes	n	230	266		168	223		160	163		298	258	
	%	40.75	45.09	- 4.34	26.98	44.08	-17.09**	38.96	26.91	12.05	27.60	31.47	- 3.87
	S.E.	4.25	3.64	5.60	4.31	4.91	6.53	5.42	3.24	6.31	3.32	3.91	5.13
2. No	%	55.82	46.67	9.15	66.99	52.29	14.69	55.09	68.41	-13.31*	67.92	65.36	2.56
	S.E.	4.80	3.67	6.04	3.30	4.75	5.78	5.20	3.71	6.39	3.73	4.18	5.60
B. Do you have an older sister good in mathematics?													
1. Yes	n	230	266		168	223		160	163		298	258	
	%	45.11	39.29	5.82	34.81	32.78	2.03	38.21	27.01	11.19	30.69	29.20	1.49
	S.E.	4.06	4.80	6.29	5.70	4.24	7.10	5.71	3.70	6.80	3.62	4.58	5.84
2. No	%	47.03	54.05	- 7.03	60.38	63.69	- 3.58	54.45	65.89	-11.44	65.22	67.06	- 1.85
	S.E.	4.44	4.75	6.50	5.21	4.41	6.83	5.86	4.28	7.26	3.81	4.63	6.00

*p<.05
**p<.01
(This table is continued on the next page.)

TABLE D (CONT.)

Variable		Level of Participation											
		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus and/or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
IV. School Experience													
A. Classify emphasis of high school courses													
1. General	n	233	266		168	224		163	167		302	259	
	%	52.49	53.96	- 1.47	35.44	44.89	- 9.45	20.83	15.83	5.00	8.97	14.17	- 5.20
	S.E.	4.81	3.92	6.21	5.39	5.67	7.82	5.24	3.96	6.57	1.58	3.30	3.66
2. Vocational technical or trade	%	38.49	27.76	8.73	20.49	17.00	3.50	15.39	12.64	2.74	3.97	2.71	1.27
	S.E.	5.50	4.61	7.18	4.07	3.97	5.69	4.33	3.91	5.83	1.67	1.13	2.02
3. College Preparatory	%	9.02	15.61	- 6.59	42.63	37.97	4.67	63.30	71.53	- 8.24	87.06	83.12	3.94
	S.E.	2.75	3.19	4.21	4.93	4.64	6.77	7.81	4.47	9.00	2.07	3.47	4.04
B. Did you take Algebra in 8th Grade?													
1. Yes	n	233	266		168	224		163	167		302	259	
	%	12.00	8.24	3.77	14.85	20.27	- 5.43	33.82	19.71	14.11*	52.45	37.35	15.10*
	S.E.	3.64	2.26	4.28	2.86	4.38	5.23	4.17	3.83	5.66	6.00	4.43	2.46
2. No	%	87.99	91.76	- 3.77	83.50	79.73	3.78	66.18	80.29	-14.11*	47.24	62.49	-15.25*
	S.E.	3.64	2.26	4.28	2.83	4.38	5.21	4.17	3.83	5.66	6.00	4.42	7.45

*p<.05
**p<.01

(This table is continued on the next page.)

TABLE D (CONT.)

Level of Participation

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus and/or Calculus		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
V. Background Variables													
A. Fathers Occupation Which group of careers does your father belong in?													
1. Artists and Entertainers	n	222	259		165	218		157	161		295	256	
	%	3.05	.90	2.15	.27	1.85	- 1.57	.21	.44	- .24	.53	.97	- .43
	S.E.	2.62	.91	2.77	.28	.95	.99	.21	.44	.49	.37	.12	.39
2. Clerical, Technical and Service Personnel	%	5.42	10.07	- 4.65	10.47	12.63	- 2.16	11.50	13.08	- 1.58	11.78	14.76	- 2.97
	S.E.	1.82	3.65	4.08	5.21	2.77	5.90	2.70	2.48	3.67	2.22	3.26	3.94
3. Executives	%	4.57	4.95	- .38	9.66	5.95	3.71	8.24	7.09	1.15	8.76	9.04	- .28
	S.E.	1.65	1.99	2.59	2.42	2.79	3.69	2.48	2.76	3.71	1.66	2.51	3.01
4. Homemaker	%	.18	.35	- .18	3.60	3.29	.31	0.00	0.00	0.00	.92	0.00	.92
	S.E.	.18	.11	.21	2.00	2.03	2.85	0.00	0.00	0.00	.51	0.00	.51
5. Management and Marketing Personnel	%	8.91	7.55	1.36	20.00	11.93	8.07	16.13	21.68	- 5.55	19.28	17.34	1.93
	S.E.	2.01	2.32	3.07	3.34	3.01	4.50	1.84	5.02	5.35	2.42	2.93	3.80
6. Professionals	%	15.33	4.47	10.87*	16.88	11.86	5.02	13.35	11.82	1.53	23.46	24.89	- 1.42
	S.E.	4.06	1.46	4.31	3.77	3.26	4.98	3.76	2.66	4.61	3.78	2.93	4.78

*p<.05
**p<.01

(This Table is continued on the next page.)

TABLE D (CONT.)

Level of Participation

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-calculus and/or Calculus		
7. Semi-skilled Workers	%	28.79	30.64	- 1.84	15.61	21.29	- 5.68	18.87	18.57	.31	11.73	15.35	- 3.61
	S.E.	4.69	4.57	6.55	4.13	3.46	5.39	6.45	3.99	7.58	2.12	2.69	3.42
8. Skilled Workers	%	29.01	31.08	- 2.06	19.11	25.41	- 6.30	23.28	20.34	2.94	18.98	12.70	6.28
	S.E.	4.21	4.76	6.35	3.88	4.89	6.24	3.74	3.52	5.14	3.01	2.50	3.91
B. Mothers Occupation Which group of careers does your mother belong in?													
1. Artists and Entertainers	n	222	259		165	218		157	161		295	256	
	%	.40	.90	- .50	2.37	.33	2.04	.73	1.74	- 1.01	.71	1.03	- .32
	S.E.	.34	.91	.97	.95	.31	1.00	.47	1.63	1.70	.41	.63	.75
2. Clerical, Technical or Service Personnel	%	21.22	17.84	3.39	24.19	26.16	-1.97	22.20	29.56	- 7.37	24.45	25.62	- 1.17
	S.E.	4.38	3.32	5.50	5.91	5.27	7.92	3.56	4.21	5.51	3.45	2.66	4.36
3. Executives	%	3.20	1.33	1.87	2.08	1.22	.86	1.94	1.55	..39	1.71	4.83	3.11
	S.E.	2.62	.82	2.75	1.64	1.17	2.01	.54	.32	.63	1.05	2.60	2.80
4. Homemaker	%	25.23	28.05	- 3.62	23.89	33.20	- 9.30	38.49	31.47	7.01	32.36	38.74	- 6.39
	S.E.	4.51	5.17	6.86	3.52	4.55	5.75	4.23	2.11	4.73	4.36	3.54	5.62
5. Management and Marketing Personnel	%	6.81	3.98	2.83	6.63	5.73	.90	4.40	3.19	1.21	8.82	2.93	5.88*
	S.E.	2.90	1.67	3.35	2.30	2.47	3.38	1.53	1.52	2.16	2.37	1.14	2.63

*p<.05
**p <.01
(This Table is continued on the next page.)

TABLE D (CONT.)

Variable		Algebra I			Geometry and/or Algebra II			Trigonometry and/or Probability/Statistics			Pre-Calculus and/or Calculus		
		Level of Participation											
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
6. Professionals	%	6.97	14.51	- 7.54	14.40	14.06	.33	9.21	9.52	- .32	17.96	16.68	1.28
	S.E.	2.21	3.06	3.77	4.49	3.31	5.58	2.44	3.32	4.12	3.48	2.48	4.27
7. Semi-skilled Workers	%	19.78	23.26	- 3.48	15.71	15.08	.64	9.95	14.77	- 4.82	9.16	5.53	3.63
	S.E.	3.35	5.04	6.05	3.15	3.84	4.97	2.41	3.04	3.88	2.52	1.31	2.84
8. Skilled Workers	%	2.46	1.87	.59	.23	2.10	- 1.87	2.04	2.13	- .09	.90	1.17	- .27
	S.E.	1.66	1.02	1.95	.24	1.40	1.42	1.23	.56	1.35	.46	.83	.95

*p<.05
**p<.01

TABLE E

ATTITUDES, INTERESTS AND EXPERIENCE OF 13 YEAR OLD STUDENTS WITHIN INTENDED PARTICIPATION LEVELS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. MEANS BY SEX

Level of Intended Participation in High School

Variable		0-2 Years			3 Years			4 Years		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Sex Role Stereotyping										
A. General Sex Role Stereotyping	$\bar{x}$	56.94	74.38	-12.44**	64.50	76.70	-12.20**	64.21	76.00	-12.39**
	S.E.	1.38	1.29	1.89	1.02	1.35	1.69	.92	1.12	1.45
	n	213	189		168	165		331	366	
B. Mathematics as a Male Domain	$\bar{x}$	65.28	78.81	-13.53**	70.20	81.78	-11.58**	72.23	83.19	- 9.96**
	S.E.	1.31	1.42	1.93	1.37	1.26	1.86	1.08	1.18	1.60
	n	213	188		168	165		331	366	
C. Men's attitudes towards Women successful in Mathematics	$\bar{x}$	58.54	62.73	- 3.37	62.96	66.33	- 3.37	64.10	66.10	- 2.00
	S.E.	1.36	1.86	2.03	1.53	1.33	2.03	1.29	1.16	1.73
	n	213	189		168	165		331	366	
II. Career Plans										
A. Mathematics Preparation Required for a Job	$\bar{x}$	2.89	2.93	- .04	3.13	3.08	.05	3.43	3.26	.17
	S.E.	.10	.14	.17	.10	.13	.16	.09	.08	.12
	n	191	171		150	146		303	335	
B. Factors Affecting Career Choice - Job Done by Opposite Sex	$\bar{x}$	45.45	50.04	- 4.59	48.69	51.93	- 3.24	43.94	49.91	- 5.97
	S.E.	2.62	1.93	3.25	2.98	1.77	3.57	1.51	1.68	2.26
	n	186	171		147	144		296	331	
C. Job Requires use of Mathematics	$\bar{x}$	53.86	52.46	1.40	58.02	56.70	1.32	61.32	60.87	.45
	S.E.	2.39	2.32	3.33	3.42	1.96	3.94	1.93	1.89	2.70
	n	188	171		145	143		297	330	

*p<.05
**p<.01
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TABLE E (CONT.)

Variable		Level of Intended Participation in High School								
		0-2 Years			3 Years			4 Years		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
III. Mathematics and Oneself										
A. Confidence in Mathematics	$\overline{x}$	57.31	55.77	1.54	68.84	59.57	9.27**	70.81	65.36	5.45**
	S.E.	1.35	1.70	2.17	1.55	2.42	2.87	1.08	1.68	2.00
	n	213	188		168	165		331	366	
B. Anxiety in Mathematics	$\overline{x}$	55.88	55.36	.52	66.32	58.88	7.44*	68.90	64.35	4.55*
	S.E.	1.19	1.53	1.94	1.51	2.30	2.75	1.36	1.61	2.11
	n	213	189		168	165		331	366	
C. Anxiety in English	$\overline{x}$	51.35	59.58	- 8.23**	55.58	58.66	- 3.08	57.65	62.63	- 4.98**
	S.E.	1.76	1.49	2.31	1.66	2.14	2.71	1.16	1.27	1.72
	n	213	188		168	165		331	366	
D. Anxiety in School	$\overline{x}$	52.84	57.25	- 4.41*	62.42	60.81	1.61	64.13	61.18	2.95
	S.E.	1.14	1.34	1.76	1.34	1.86	2.29	1.15	1.17	1.64
	n	213	188		168	165		331	366	
E. Enjoyment of Mathematics	$\overline{x}$	45.28	45.37	- .09	56.68	49.92	6.76*	60.72	59.19	1.53
	S.E.	2.00	2.08	2.89	1.86	2.02	2.75	1.61	1.67	2.32
	n	213	188		168	165		331	366	
F. Locus of control in Mathematics	$\overline{x}$	66.88	59.73	7.15*	61.98	67.10	- 5.12	70.41	67.00	3.41
	S.E.	1.96	2.04	2.83	3.76	2.30	4.41	1.74	1.86	2.55
	n	212	187		166	164		331	364	
G. Mathematics and Oneself Composit	$\overline{x}$	54.43	53.79	.64	65.34	57.94	7.40**	68.27	64.28	3.99
	S.E.	1.21	1.45	1.89	1.31	2.06	2.44	1.12	1.40	1.79
	n	213	188		168	165	331	366		

*p<.05
**p<.01
(This Table is Continued on the next page.)

TABLE E (CONT.)

Variable		Level of Intended Participation in High School								
		0-2 Years			3 Years			4 Years		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
IV. Usefulness of Mathematics to the Individual	$\bar{x}$	67.85	70.73	- 2.88	78.30	75.28	3.02	81.40	78.94	2.46
	S.E.	1.24	1.40	1.87	.96	1.14	1.49	.76	.99	1.25
	n	213	189		168	165		331	366	
V. Academic Plans										
A. Educational Aspirations	$\bar{x}$	2.69	2.95	- .26	3.05	3.45	.40	3.50	3.56	- .06
	S.E.	.13	.10	.16	.11	.11	.15	.06	.08	.10
	n	213	189		168	165		331	366	
VI. Parental Influences										
A. Father as a Role Model	$\bar{x}$	67.47	69.93	- 2.46	72.50	73.54	- 1.04	75.55	74.53	1.02
	S.E.	1.90	1.22	2.26	2.00	1.63	2.58	1.19	1.55	1.95
	n	204	186		167	162		323	359	
B. Mother as a Role Model	$\bar{x}$	63.72	64.14	- .42	68.88	65.31	3.57	70.76	69.36	1.40
	S.E.	1.65	1.74	2.40	1.59	1.55	2.22	1.18	1.25	1.72
	n	203	187		166	162		324	359	
C. Fathers Encouragement	$\bar{x}$	69.17	71.34	- 2.17	74.84	75.13	- .29	78.20	76.18	2.02
	S.E.	1.45	1.14	1.84	1.10	.81	1.37	.98	.85	1.30
	n	203	186		167	162		323	359	
D. Mothers Encouragement	$\bar{x}$	71.38	74.51	- 3.13	77.91	77.90	.01	80.62	79.96	.66
	S.E.	1.43	1.02	1.76	1.13	.77	1.37	1.03	.86	1.34
	n	202	187		166	162		324	359	

$*p<.05$
$**p<.01$

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TABLE E (CONT.)

Variable		Level of Intended Participation in High School								
		0-2 Years			3 Years			4 Years		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
E. Fathers Stereotyping of Mathematics	$\bar{x}$	64.34	73.17	- 8.83**	67.03	73.15	- 6.12	69.18	74.29	- 5.09**
	S.E.	1.87	1.81	2.60	2.65	2.12	3.39	1.30	1.51	1.99
	n	203	186		167	162		323	358	
F. Mothers Stereotyping of Mathematics	$\bar{x}$	65.76	74.09	- 8.33**	68.07	77.10	- 9.03**	70.19	77.51	- 7.32
	S.E.	2.51	1.63	2.99	2.18	1.97	2.94	1.23	1.51	1.95
	n	201	187		166	162		324	359	
G. Fathers Educational Expectations	$\bar{x}$	45.87	52.40	- 6.53	56.60	57.72	- 1.72	62.87	61.54	1.33
	S.E.	3.92	3.73	5.41	3.56	4.17	5.48	2.33	2.72	3.58
	n	144	108		119	96		250	232	
H. Mothers Educational Expectations	$\bar{x}$	46.44	54.15	- 7.71	57.76	58.80	- 1.04	65.95	62.45	3.50
	S.E.	4.34	3.33	5.47	2.90	3.85	4.82	2.52	2.13	3.30
	n	148	124		125	116		262	270	
VII. Influences of Significant Others										
A. Peer Influence	$\bar{x}$	63.13	67.14	- 4.01**	69.14	68.48	.66	70.83	70.98	- .15
	S.E.	.97	.74	1.22	.98	1.28	1.61	.92	.97	1.34
	n	203	188		167	161		324	358	
B. Boys Stereotyping of Mathematics	$\bar{x}$	56.04	62.14	- 6.10**	57.76	60.98	- 3.22	59.58	62.06	- 2.48
	S.E.	2.29	1.65	2.82	2.24	1.76	2.85	1.40	1.54	2.08
	n	202	187		167	160		324	354	
C. Girls Stereotyping of Mathematics	$\bar{x}$	60.15	73.25	-13.10**	65.63	70.37	- 4.74	63.79	74.65	-10.86**
	S.E.	1.90	1.89	2.68	1.90	2.26	2.95	1.46	1.26	1.93
	n	201	188		165	161		321	357	

*p<.05
**p<.01

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TABLE E (CONT.)

Variable		Level of Intended Participation in High School								
		0-2 Years			3 Years			4 Years		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
D. Counselor Encouragement	$\bar{x}$	57.55	52.51	5.04	69.61	75.18	- 5.57	66.09	72.20	- 6.11
	S.E.	2.95	3.62	4.67	3.05	4.58	5.50	3.16	3.19	4.49
	n	111	57		69	43		145	128	
E. Teacher Encouragement	$\bar{x}$	62.10	67.23	- 5.13**	67.97	67.59	.38	71.39	72.70	- 1.31
	S.E.	1.21	1.22	1.72	1.07	1.36	1.73	1.12	1.01	1.51
	n	203	188		167	161		323	357	
F. Teacher Stereotyping of Mathematics	$\bar{x}$	67.66	75.69	- 8.03**	69.96	76.59	- 6.63**	70.54	76.82	- 6.28
	S.E.	1.89	1.14	2.21	1.80	2.18	2.83	1.17	1.33	1.77
	n	202	188		167	160		318	358	
G. Teacher Differential Treatment	$\bar{x}$	64.74	72.05	- 7.31**	69.05	74.17	- 5.12**	70.08	74.08	- 4.00
	S.E.	1.13	1.19	1.64	1.41	1.08	1.78	1.03	1.14	1.54
	n	203	188		167	161		323	358	
VIII. School Experience										
A. Grades in Mathematics	$\bar{x}$	2.26	2.36	.10	2.73	2.75	.02	2.83	2.99	.16
	S.E.	.11	.08	.14	.07	.11	.13	.06	.07	.09
	n	213	189		168	165		331	366	
IX. Background Variables										
A. Fathers Education	$\bar{x}$	4.19	4.49	- .30	3.94	4.22	- .29	3.97	4.16	.19
	S.E.	.28	.28	.39	.28	.23	.36	.18	.20	.27
	n	191	171		150	146		303	335	
B. Mothers Education	$\bar{x}$	3.77	3.83	.05	3.56	3.67	.11	3.78	3.64	.14
	S.E.	.29	.29	.41	.26	.25	.36	.19	.17	.26
	n	191	171		150	146		303	335	

*p<.05
**p<.01

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TABLE E (CONT.)

Variable		Level of Intended Participation in High School								
		0-2 Years			3 Years			4 Years		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
C. Socioeconomic Status Index	$\overline{x}$	70.21	72.65	- 2.44	73.80	73.59	.21	74.87	72.94	1.92
	S.E.	1.44	.99	1.75	1.31	1.45	1.95	.99	1.02	1.42
	n	188	170		146	145		297	230	

*p<.05
**p<.01

TABLE F

ASPIRATIONS, CURRENT ENVIRONMENT AND BACKGROUND OF 13 YEAR OLD STUDENTS WITHIN INTENDED PARTICIPATION LEVELS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY. PERCENTAGES GIVING EACH RESPONSE.

Level of Intended Participation in High School

Variable		0-2 Years			3 Years, etc.			4 Years, etc.		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Career Aspirations										
A. Artists and Entertainers	n	191	171		150	146		303	335	
	%	13.01	17.57	- 4.54	13.93	13.21	.72	14.04	15.01	- .97
	S.E.	2.44	3.31	4.11	2.83	2.91	4.06	1.84	2.43	3.05
B. Clerical, Technical and Service Personnel	%	8.88	16.28	- 7.40	14.30	15.13	- .83	11.63	13.97	- 2.34
	S.E.	2.57	2.77	3.78	3.99	2.97	4.97	1.63	1.83	2.45
C. Executives	%	3.02	6.52	- 3.50	5.98	1.23	4.76	5.29	1.59	3.70
	S.E.	1.19	2.25	2.55	2.01	1.07	2.28	1.78	.75	1.93
D. Homemaker	%	3.75	6.54	- 2.79	1.14	2.03	- .89	1.92	4.44	- 2.52
	S.E.	1.78	2.45	3.03	1.15	1.24	1.69	.81	1.26	1.50
E. Management and Marketing Personnel	%	8.41	4.32	4.10	3.69	5.36	- 1.67	8.81	2.79	6.02
	S.E.	2.42	1.62	2.91	2.02	2.92	3.55	1.71	1.14	2.06
F. Professionals	%	12.95	29.88	-16.93**	22.51	46.12	-23.60**	24.68	43.56	-18.88**
	S.E.	2.34	3.94	4.58	4.12	5.67	7.01	2.46	2.64	3.61
G. Semi-Skilled Workers	%	13.00	2.28	10.72**	13.08	5.35	7.73	7.06	2.78	4.29*
	S.E.	2.85	1.14	3.07	4.32	2.32	4.90	1.84	.98	2.08
H. Skilled Workers	%	21.29	4.78	16.51**	16.18	3.55	12.63**	15.17	3.20	11.97
	S.E.	3.66	1.43	3.93	2.98	1.36	3.28	2.38	.99	2.58

*$p<.05$
**$p<.01$
(This Table is continued on the next page.)

TABLE F (CONT.)

Variable		Level of Intended Participation in High School								
		0-2 Years			3 Years, etc.			4 Years, etc.		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
II. Parental Influences										
A. Who helped more with Mathematics homework?										
1. Father	n	205	188		167	162		327	359	
	%	24.61	21.91	2.70	23.07	29.47	- 6.39	25.81	26.77	- .96
	S.E.	3.13	3.31	4.56	4.10	4.46	6.06	2.69	3.13	4.13
2. Mother	%	42.08	38.20	3.87	37.52	35.89	1.64	31.73	34.28	2.55
	S.E.	3.92	3.96	5.57	3.20	5.18	6.09	2.72	2.69	3.83
3. Both Equally	%	15.84	20.30	- 4.46	26.08	20.03	6.06	27.10	23.42	3.69
	S.E.	2.76	3.36	4.35	4.28	4.22	6.01	2.53	2.16	3.33
4. Neither Helped	%	14.01	19.01	- 5.00	13.18	14.61	- 1.42	13.12	15.10	- 1.98
	S.E.	2.59	2.86	3.86	3.61	3.86	5.29	1.87	2.75	3.33
B. Who uses more mathematics in your home?										
1. Mother	n	205	188		167	162		327	359	
	%	26.50	29.39	- 2.89	29.66	24.96	4.70	29.19	26.32	2.87
	S.E.	4.74	3.15	5.69	4.25	4.02	5.85	2.35	3.15	3.93
2. Father	%	43.85	34.04	9.80	45.36	43.44	1.93	39.62	32.43	7.20
	S.E.	4.83	3.36	5.88	4.75	4.28	6.39	2.98	3.44	4.55
3. Both the Same	%	25.39	35.74	-10.35	24.98	30.59	- 5.62	29.29	40.76	-11.47
	S.E.	4.04	3.45	5.31	4.11	2.70	4.92	2.24	3.13	3.85

*p<.05
**p<.01

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TABLE F (CONT.)

Level of Intended Participation in High School

Variable		0-2 Years			3 Years, etc.			4 Years, etc.		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
C. Family Status										
Which adult do you live with?										
Just Father	n	204	188		167	161		326	358	
	%	1.53	3.80	- 2.27	1.30	1.02	.29	2.64	1.34	1.30
	S.E.	.81	1.64	1.83	.86	1.01	1.33	.91	.68	1.14
Just Mother	%	16.57	20.38	- 3.81	14.39	14.83	- .44	13.42	18.53	- 5.11
	S.E.	2.52	3.01	3.93	3.01	4.37	5.31	2.43	3.22	4.03
Both Parents	%	76.18	72.01	4.18	80.40	83.03	- 2.63	79.12	75.72	3.41
	S.E.	3.03	3.96	4.99	3.32	4.19	5.35	2.31	3.14	3.90
Other	%	4.65	2.85	1.80	3.00	.48	2.51	3.31	3.61	- .30
	S.E.	1.77	1.45	2.29	2.00	.34	2.03	1.15	1.29	1.73
D. If you live with only one parent, do you see the other often?										
Yes	n	204	188		167	161		326	358	
	%	12.68	13.22	- .53	9.31	5.39	3.92	11.46	10.84	.63
	S.E.	2.17	3.65	4.25	3.10	2.42	3.93	2.08	2.29	3.09
No	%	16.55	17.61	- 1.07	11.49	12.09	- .60	12.97	13.11	- .14
	S.E.	3.43	2.28	4.12	2.57	4.14	4.87	2.36	1.98	3.08
I live with both parents	%	67.87	67.87	0.00	77.14	81.89	- 4.76	73.05	74.81	- 1.75
	S.E.	3.56	4.01	5.36	3.32	4.34	5.46	2.82	3.76	4.70

*p<.05
**p<.01
(This Table is continued on the next page.)

TABLE F (CONT.)

Variable		0-2 Years Male	0-2 Years Female	0-2 Years Difference	3 Years, etc. Male	3 Years, etc. Female	3 Years, etc. Difference	4 Years, etc. Male	4 Years, etc. Female	4 Years, etc. Difference
III. Influence of Significant Others										
A. Do you have an older brother good in Mathematics?										
Yes	n	204	188		167	161		326	358	
	%	38.59	39.33	- .73	41.68	35.64	6.03	36.28	42.03	- 5.76
	S.E.	4.02	3.76	5.50	4.77	4.33	6.44	3.07	2.59	4.02
No	%	51.07	54.94	- 3.87	54.02	59.03	- 5.01	53.69	54.75	- 1.06
	S.E.	3.81	3.91	5.46	4.18	4.30	6.00	3.20	2.87	4.30
B. Do you have an older sister good in Mathematics?										
Yes	n	204	188		167	161		326	358	
	%	49.28	46.50	2.78	42.51	41.27	1.24	41.90	45.15	- 3.26
	S.E.	3.74	3.25	4.96	4.68	4.13	6.42	3.27	2.95	4.40
No	%	41.68	47.43	- 5.75	54.49	55.30	- .81	51.15	50.00	1.15
	S.E.	3.24	2.86	4.32	4.91	4.25	6.49	3.50	3.14	4.70
IV. School Experience										
A. Did you take, or do you plan to take, Algebra in 8th grade?										
Yes	n	213	189		168	165		331	366	
	%	15.89	16.03	- .14	11.60	22.21	-10.61*	16.27	26.20	- 9.92*
	S.E.	3.13	4.25	5.28	2.55	3.72	4.51	2.72	2.92	3.99
No	%	60.60	63.84	- 3.24	71.68	59.95	11.73*	59.87	56.53	3.35
	S.E.	3.88	5.39	6.64	3.93	4.00	5.61	3.41	3.56	4.93

Level of Intended Participation in High School

(This Table is continued on the next page.)

TABLE F (CONT.)

Variable		Level of Intended Participation in High School 0-2 Years			3 Years, etc.			4 Years, etc.		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
V. Backgroun Variables										
A. Fathers Occupation. Which group of careers does your father belong in?										
1. Artists and Entertainers	n	191	171		150	146		303	335	
	%	1.20	0.00	1.20	1.53	2.82	- 1.29	1.85	.40	1.45
	S.E.	.90	0.00	.90	1.08	1.56	1.90	.97	.34	1.03
2. Clerical, Technical and Service Personnel	%	12.91	9.80	3.11	12.26	12.41	- 1.16	12.40	12.65	- 1.25
	S.E.	2.48	2.91	3.82	2.92	3.43	4.50	2.32	2.31	3.27
3. Executives	%	6.85	8.93	- 2.08	8.43	7.52	.10	7.01	7.98	- .97
	S.E.	2.54	2.54	3.59	2.25	2.43	3.31	1.61	1.54	2.23
4. Homemaker	%	1.52	1.78	- .26	0.00	1.02	- 1.02	2.34	2.53	- .19
	S.E.	.99	1.24	1.59	0.00	1.04	1.04	.97	1.09	1.46
5. Management and Marketing Personnel	%	13.32	8.49	4.83	11.05	16.94	- 5.90	12.94	13.48	- .55
	S.E.	2.11	2.15	3.01	3.18	3.24	4.54	1.96	2.42	3.11
6. Professionals	%	8.55	9.08	- .52	6.95	6.86	.09	9.68	10.00	- .32
	S.E.	2.20	2.87	3.62	1.95	2.25	2.98	1.62	1.93	2.52
7. Semi-skilled Workers	%	17.85	19.42	- 1.57	30.01	15.99	14.02*	23.53	22.09	1.43
	S.E.	3.57	2.95	4.63	4.25	3.64	5.60	3.65	2.48	4.41

*p<.05
**p<.01
(This Table is continued on the next page.)

TABLE F (CONT.)

Level of Intended Participation in High School

Variable		0-2 Years			3 Years, etc.			4 Years, etc.		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
8. Skilled Workers	%	28.96	24.83	4.04	19.91	28.60	- 8.68	19.10	18.93	.18
	S.E.	2.86	4.17	5.06	3.75	6.11	7.17	2.78	2.43	3.69
B. Mothers Occupation. Which group of careers does your mother belong in?										
1. Artists and Entertainers	n	191	171		150	146		303	335	
	%	5.56	1.59	3.96	1.35	2.41	- 1.05	2.11	1.42	.69
	S.E.	2.39	1.11	2.64	.99	1.80	2.05	.99	.67	1.20
2. Clerical, Technical or Service Personnel	%	13.70	16.42	- 2.73	21.29	19.69	1.59	19.13	19.98	- .85
	S.E.	2.81	2.76	3.94	3.85	4.24	5.73	2.39	2.58	3.52
3. Executives	%	4.23	2.78	1.45	2.02	2.30	- .28	6.32	2.93	3.39
	S.E.	1.78	1.20	2.15	1.13	1.51	1.89	1.66	1.10	1.99
4. Homemaker	%	26.66	26.28	.37	26.68	32.25	- 5.56	24.08	30.78	- 6.70
	S.E.	3.05	4.22	5.21	4.82	4.36	6.50	2.37	3.00	3.82
5. Management and Marketing Personnel	%	9.55	7.34	2.21	6.80	7.48	- .69	3.88	6.85	- 2.97
	S.E.	2.39	2.22	3.26	2.30	2.28	3.24	.93	1.79	2.02
6. Professionals	%	5.57	10.26	- 4.69	13.61	8.82	4.79	12.31	13.52	- 1.21
	S.E.	1.69	3.23	3.65	2.65	1.89	3.25	1.74	2.41	2.97

*p<.05
**p<.01

(This table is continued on the next page.)

TABLE F (CONT.)

Level of Intended Participation in High School

Variable		0-2 Years			3 Years, etc.			4 Years, etc.		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
7. Semi-Skilled Workers	%	12.47	17.10	-4.64	7.63	20.35	-12.72*	12.68	12.23	.45
	S.E.	2.82	3.12	4.21	1.91	5.05	5.40	2.66	1.61	3.11
8. Skilled Workers	%	5.15	1.30	3.86*	3.44	2.29	1.14	2.72	2.43	.29
	S.E.	1.53	.90	1.78	1.60	1.24	2.07	1.16	.97	1.51

*p<.05
**p<.01

TABLE G

ATTITUDES AND INTERESTS OF GRADE 12 STUDENTS WITHIN ACHIEVEMENT LEVELS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. MEANS BY SEX.

		Level of Achievement								
Variable		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Sex Role Stereotyping										
A. General Sex Role Stereotyping	$\bar{x}$	61.02	78.99	-17.97**	64.59	82.11	-16.52**	63.21	80.68	-17.47**
	S.E.	2.91	.72	3.00	1.64	.97	1.91	1.24	1.09	1.65
	n	211	256		247	290		399	370	
B. Mathematics as a Male Domain	$\bar{x}$	67.27	81.04	-13.77**	76.27	86.63	-10.36**	74.11	88.45	-14.34**
	S.E.	2.22	1.02	2.44	1.24	1.06	1.63	.99	.87	1.32
	n	211	256		247	290		399	370	
C. Men's Attitudes toward women successful in mathematics	$\bar{x}$	63.31	69.22	- 5.91**	68.38	70.91	- 2.53	67.29	72.40	- 5.11
	S.E.	1.88	1.02	2.14	1.27	1.23	1.77	.95	1.18	1.51
	n	211	256		247	290		399	370	
II. Career Plans										
A. Mathematics Preparation Required for a Job (in Years)	$\bar{x}$	2.57	2.53	.04	2.88	2.75	.13	3.73	3.59	.14
	S.E.	.11	.12	.16	.14	.08	.17	.09	.10	.14
	n	247	204		281	237		366	391	
B. Factors Affecting Career Choice - Job Done by Opposite Sex	$\bar{x}$	45.61	53.54	- 7.93*	37.29	49.89	-12.60**	40.03	52.21	-12.18**
	S.E.	2.48	1.99	3.18	1.45	1.46	2.06	1.44	.83	1.66
	n	246	199		280	237		364	391	

*$p<.05$

**$p<.01$

(This Table is continued on the next page.)

TABLE G (CONT.)

Variable		Low			Middle			High		
		Level of Achievement								
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
C. Job Requires use of Mathematics	$\bar{x}$	48.74	52.38	- 3.64	52.65	48.41	4.24	62.50	58.60	3.90
	S.E.	2.39	2.83	3.70	2.34	1.67	2.87	1.49	1.49	2.11
	n	247	199		281	236		364	391	
III. Mathematics and Oneself										
A. Confidence in Mathematics	$\bar{x}$	52.77	46.80	5.97	59.98	52.03	7.95**	73.56	71.98	1.58
	S.E.	2.14	2.44	3.25	2.20	1.94	2.93	1.18	1.20	1.68
	n	211	256		247	290		399	370	
B. Anxiety in Mathemematics	$\bar{x}$	54.17	49.23	4.94	60.63	54.14	6.49*	69.23	66.25	2.98
	S.E.	2.06	2.33	3.11	1.96	2.33	3.04	1.28	1.35	1.86
	n	211	256		247	290		399	370	
C. Anxiety in English	$\bar{x}$	56.70	64.34	- 7.64**	58.48	68.69	-10.21**	60.55	66.83	- 6.28*
	S.E.	1.83	1.73	2.52	1.96	1.19	2.29	2.27	1.66	2.81
	n	211	256		247	290		399	370	
D. Anxiety in School	$\bar{x}$	58.43	62.89	- 4.46*	65.29	66.08	- .79	69.55	69.39	.16
	S.E.	1.63	1.43	2.17	1.09	.97	1.46	1.19	1.25	1.73
	n	211	256		247	290		399	370	
E. Enjoyment of Mathematics	$\bar{x}$	43.21	45.42	- 2.21	51.31	48.62	2.69	61.81	65.26	- 3.45
	S.E.	2.34	1.82	2.96	2.61	1.61	3.07	1.25	1.27	1.78
	n	211	256		247	290		399	370	
F. Locus of Control in Mathematics	$\bar{x}$	69.15	63.88	5.27	70.37	65.09	5.28	76.45	68.89	7.56**
	S.E.	2.71	2.18	3.48	2.28	2.13	3.12	1.96	2.03	2.82
	n	256	209		289	246		369	397	
G. Mathematics and Oneself Composite	$\bar{x}$	51.78	48.65	3.13	58.92	53.08	5.84*	69.12	68.47	.65
	S.E.	1.87	2.14	2.84	1.96	1.81	2.67	1.06	1.0[illegible]	1.52
	n	211	256		247	290		399	370	

(This Table is continued on the next page.)

TABLE G (CONT.)

Variable		Level of Achievement								
		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
IV. Usefulness of Mathematics to the Individual	$\bar{x}$	68.21	69.41	- 1.20	74.49	69.91	4.58*	79.26	78.71	.55
	S.E.	1.67	1.57	2.29	1.30	1.59	2.05	1.24	.93	1.55
	n	399	370		247	290		211	256	
V. Academic Plans										
A. Educational Expectations	$\bar{x}$	2.62	3.05	- .43	3.13	3.40	- .27	4.12	4.06	.06
	S.E.	.16	.09	.18	.11	.09	.14	.09	.09	.13
	n	256	211		290	247		370	399	
VI. Parental Influences										
A. Father as a Role Model	$\bar{x}$	66.91	65.53	1.38	71.46	69.99	1.47	75.61	72.72	2.89
	S.E.	1.82	1.62	2.44	1.90	1.68	2.54	.79	2.00	2.15
	n	210	251		244	290		395	365	
B. Mother as a Role Model	$\bar{x}$	68.39	68.29	.10	61.63	63.60	- 1.97	62.12	62.98	- .86
	S.E.	1.83	1.61	2.44	1.75	1.51	2.31	1.50	1.25	1.95
	n	209	252		245	290		396	366	
C. Father's Encouragement	$\bar{x}$	64.31	62.12	2.19	68.88	64.65	4.23*	75.31	75.30	.01
	S.E.	1.91	1.19	2.25	1.35	1.52	2.03	1.17	1.28	1.73
	n	209	251		244	290		396	366	
D. Mother's Encouragement	$\bar{x}$	68.02	68.40	- .38	69.99	68.77	1.22	77.01	76.92	.09
	S.E.	1.38	1.25	1.86	1.61	1.68	2.33	.86	1.17	1.45
	n	208	253		245	290		396	368	
E. Father's Stereotyping of Mathematics	$\bar{x}$	63.62	75.90	-12.28**	65.59	73.87	- 8.28**	64.92	77.66	-12.74**
	S.E.	3.06	2.15	3.74	1.71	1.32	2.16	1.68	1.38	2.17
	n	251	209		290	244		367	394	

(This Table is continued on the next page.)

TABLE G (CONT.)

Variable		Level of Achievement Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
F. Mothers Stereotyping of Mathematics	$\bar{x}$	65.73	77.36	-11.63**	66.34	76.71	-10.37**	65.20	78.89	-13.69
	S.E.	2.89	1.89	3.45	1.74	1.49	2.29	1.83	1.18	2.18
	n	251	208		290	245		368	294	
G. Fathers Educational Expectations	$\bar{x}$	4.21	4.44	- .23	4.29	4.54	- .25	4.51	4.69	- .18
	S.E.	.23	.29	.38	.20	.23	.31	.14	.20	.24
	n	182	168		223	195		312	338	
H. Mothers Educational Expectations	$\bar{x}$	3.82	3.77	.05	4.49	3.90	.59	4.49	4.23	.26
	S.E.	.29	.19	.34	.25	.18	.31	.16	.14	.21
	n	221	179		244	199		333	352	
VII. Influences of Significant Others										
A. Peer Influence	$\bar{x}$	65.34	70.87	- 5.53**	69.92	73.31	- 3.39**	72.83	75.78	- 2.95*
	S.E.	1.33	.95	1.63	.78	.57	.97	.75	.93	1.19
	n	207	252		245	289		397	369	
B. Boys Stereotyping of	$\bar{x}$	65.91	68.09	- 2.18	63.34	64.19	- .85	60.43	68.30	- 7.87**
	S.E.	1.98	1.36	2.40	1.32	1.75	2.19	1.84	2.18	2.85
	n	252	206		289	245		368	396	
C. Girls Stereotyping of Mathematics	$\bar{x}$	64.19	75.60	-11.41**	67.16	78.65	-11.49**	67.47	78.47	-11.00**
	S.E.	1.72	1.28	2.14	1.86	1.32	2.28	1.97	1.39	2.41
	n	251	205		288	245		368	397	
D. Counselor Encouragement	$\bar{x}$	69.35	69.30	.05	69.10	73.90	- 4.80	79.22	79.83	- .61
	S.E.	4.72	2.43	5.31	2.68	2.22	3.48	1.77	1.58	2.37
	n	126	124		151	145		231	270	

(This Table is continued on the next page.)

TABLE G (CONT.)

Variable		Level of Achievement								
		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
E. Teacher Encouragement	$\bar{x}$	59.48	63.99	- 4.51	66.36	65.06	1.30	72.53	76.86	- 4.33**
	S.E.	2.22	1.56	2.71	1.18	1.30	1.76	.71	1.00	1.23
	n	207	252		245	289		397	369	
F. Teacher Stereotyping of Mathematics	$\bar{x}$	70.42	77.36	- 6.94*	72.75	75.68	- 2.93*	74.75	79.05	- 4.30
	S.E.	2.53	1.54	2.96	1.54	1.06	1.87	1.83	1.20	2.19
	n	207	252		245	289		397	369	
G. Teacher Differential Treatment	$\bar{x}$	66.24	74.05	- 7.81**	70.97	74.59	- 2.62*	72.96	77.45	- 4.49**
	S.E.	1.04	1.13	1.54	1.11	.99	1.49	1.19	1.02	1.57
	n	207	251		245	289		397	369	
VIII. School Experience										
A. Grades in Mathematics	$\bar{x}$	2.26	2.30	.04	2.53	2.55	.02	3.04	3.38	.34
	S.E.	.11	.07	.14	.09	.07	.12	.05	.05	.08
	n	256	211		290	247		370	399	
IX. Background Variables										
A. Fathers Education	$\bar{x}$	3.13	3.32	- .19	3.19	3.16	.03	3.33	3.07	.25
	S.E.	.33	.22	.40	.18	.20	.27	.16	.12	.20
	n	201	173		261	212		350	377	
B. Mothers Education	$\bar{x}$	2.67	2.73	- .06	2.77	2.79	- .02	2.94	2.69	.25
	S.E.	.24	.29	.38	.20	.12	.23	.14	.10	.18
	n	221	179		271	221		357	377	
C. SES	$\bar{x}$	72.01	68.54	3.47	75.23	74.30	.93	78.08	76.51	1.57
	S.E.	1.05	1.54	1.86	1.32	1.52	2.01	.97	.99	1.39
	n	221	179		271	221		357	377	

*$p<.05$
**$p<.01$

TABLE H

ATTITUDES AND INTERESTS OF 13 YEAR OLD STUDENTS WITHIN ACHIEVEMENT LEVELS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. MEANS BY SEX

Variable		Level of Achievement								
		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Sex Role Stereotyping										
A. General Sex Role Stereotyping	$\bar{x}$	57.85	69.30	-11.45**	63.37	76.15	-12.78**	66.00	80.81	-14.81**
	S.E.	1.55	1.07	1.88	1.11	.92	1.44	1.26	1.05	1.64
	n	201	245		257	247		256	208	
B. Mathematics as a Male Domain	$\bar{x}$	64.19	73.07	- 8.88**	71.16	80.51	- 9.35**	74.65	87.87	-13.22**
	S.E.	1.38	1.13	1.78	1.07	.92	1.41	1.26	.79	1.49
	n	201	245		257	247		255	208	
C. Men's Attitudes Toward Women Successful in Mathematics	$\bar{x}$	59.10	58.22	.88	62.74	65.95	- 3.21	65.83	69.94	- 4.11*
	S.E.	1.05	1.29	1.66	1.18	1.16	1.65	1.36	1.16	1.79
	n	201	245		257	247		256	208	
II. Career Plans										
A. Mathematics Preparation Required for a Job	$\bar{x}$	3.24	3.21	.02	3.08	3.13	- 5.01**	3.38	3.07	.30
	S.E.	.11	.12	.16	.11	.09	.14	.15	.09	.18
	n	192	228		237	228		226	188	
B. Factors Affecting Career Choice - Job Done by Opposite Sex	$\bar{x}$	50.55	48.32	2.23	42.55	50.67	- 8.12**	43.04	51.62	- 8.58**
	S.E.	2.20	1.60	2.72	1.84	1.94	2.67	1.71	1.80	2.48
	n	190	223		234	223		224	187	
C. Job Requires Use of Mathematics	$\bar{x}$	55.09	57.87	- 2.78	58.76	55.71	3.05	62.07	58.57	3.50
	S.E.	2.64	2.16	3.41	2.04	2.07	2.91	1.99	1.72	2.63
	n	191	224		231	223		224	187	

*p<.05
**p<.01

(This Table is continued on the next page.)

E-45

TABLE H (CONT.)

Variable		Level of Achievement								
		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
III. Mathematics and Oneself										
A. Confidence in Mathematics	$\bar{x}$	59.22	52.55	6.67**	65.83	62.08	3.75	76.32	68.25	8.07**
	S.E.	1.45	1.43	2.04	1.17	1.78	2.13	1.75	2.58	3.12
	n	201	245		257	247		255	208	
B. Anxiety in Mathematics	$\bar{x}$	57.86	52.69	4.17*	65.36	61.80	3.56	71.95	65.41	6.54
	S.E.	1.24	1.32	1.81	1.24	1.58	2.01	1.99	2.66	3.32
	n	201	245		257	247		256	208	
C. Anxiety in English	$\bar{x}$	54.68	55.74	- 1.06	53.65	60.45	- 6.80**	58.49	65.81	- 7.32**
	S.E.	1.80	1.44	2.31	1.27	1.39	1.88	1.31	1.38	1.90
	n	201	245		257	247		255	208	
D. Anxiety in School	$\bar{x}$	54.54	54.42	.12	61.96	60.26	1.70	65.51	64.50	1.01
	S.E.	1.24	.99	1.59	1.14	1.10	1.58	1.35	1.51	2.03
	n	201	245		257	247		255	208	
E. Enjoyment of Mathematics	$\bar{x}$	51.22	53.43	- 2.21	55.36	52.02	3.34	60.77	55.10	5.67
	S.E.	1.70	1.76	2.45	1.57	2.26	2.75	2.48	2.22	3.33
	n	201	245		257	247		256	208	
F. Locus of Control in Mathematics	$\bar{x}$	62.33	63.39	- 1.06	69.14	65.56	3.58	70.61	66.51	4.10
	S.E.	2.04	2.14	2.96	2.53	1.68	3.04	2.66	2.64	3.75
	n	198	241		256	246		255	208	
G. Mathematics and Oneself Composite	$\bar{x}$	57.58	54.60	2.98	63.77	60.32	3.45	70.99	64.37	6.62*
	S.E.	1.18	1.16	1.65	1.15	1.59	1.96	1.85	2.32	2.97
	n	201	245		257	247		256	208	
IV. Usefullness of Mathematics to the Individual	$\bar{x}$	71.87	72.52	- .65	77.77	76.00	1.77	81.51	78.73	2.78
	S.E.	1.10	.93	1.44	.95	.87	1.29	.97	.90	1.32
	n	201	245		257	247		256	208	

(This Table is continued on the next page.)

TABLE H (CONT.)

Variable		Level of Achievement								
		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
V. Academic Plans										
A. Educational Expectations	$\bar{x}$	2.83	2.89	- .06	3.03	3.34	- .31	3.64	3.74	- .10
	S.E.	.09	.10	.14	.08	.09	.12	.10	.10	.15
	n	201	245		257	247		256	208	
VI. Parental Influence										
A. Father as a Role Model	$\bar{x}$	67.26	70.80	- 3.54	74.03	71.48	2.55	76.20	76.05	.15
	S.E.	1.73	1.53	2.31	1.62	1.46	2.18	1.21	1.76	2.14
	n	199	244		256	245		256	208	
B. Mother as a Role Model	$\bar{x}$	67.71	68.73	- 1.02	68.21	68.27	- .06	68.97	64.61	-4.36*
	S.E.	1.01	1.24	1.60	1.43	1.34	1.96	1.35	1.40	1.94
	n	200	244		256	245		256	207	
C. Father's Encouragement	$\bar{x}$	72.41	73.72	- 1.31	74.89	72.99	1.90	77.44	76.62	.82
	S.E.	.95	.88	1.29	1.11	.91	1.44	1.11	1.11	1.57
	n	199	244		256	244		256	208	
D. Mother's Encouragement	$\bar{x}$	75.65	76.92	- 1.27	76.75	77.11	- .36	80.07	79.54	.53
	S.E.	.98	1.09	1.47	1.04	.84	1.34	1.13	.90	1.44
	n	200	244		256	244		256	207	
E. Father's Stereotypying of Mathematics	$\bar{x}$	65.77	71.85	- 6.08*	66.73	73.73	- 7.00**	69.08	75.34	- 6.26*
	S.E.	1.70	2.08	2.69	1.55	1.59	2.22	2.06	1.67	2.65
	n	199	244		255	243		256	208	
F. Mother's Stereotyping of Mathematics	$\bar{x}$	67.20	73.60	- 6.40*	67.82	76.72	- 8.90**	70.35	78.67	- 8.32**
	S.E.	1.62	2.15	2.69	1.66	1.68	2.36	1.88	1.99	2.74
	n	200	244		256	242		256	207	

(This Table is continued on the next page.)

TABLE H (CONT.)

Variable		Level of Achievement								
		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
G. Fathers Educational Expectations	$\bar{x}$	4.56	5.58	- 1.02**	4.57	5.43	- .86	5.12	5.52	- .40
	S.E.	.19	.28	.34	.18	.16	.24	.30	.23	.36
	n	111	177		156	183		171	156	
H. Mothers Educational Expectations	$\bar{x}$	4.39	4.94	- .55	4.42	4.93	- .51	4.96	5.05	- .09
	S.E.	.21	.27	.34	.17	.17	.24	.19	.18	.27
	n	138	191		180	192		195	156	
VII. Influences of Significant Others										
A. Peer Influence	$\bar{x}$	64.51	65.72	- 1.21	68.78	69.66	- .88	71.94	71.95	- .01
	S.E.	1.19	1.08	1.61	.81	.93	1.23	1.36	.98	1.68
	n	198	244		256	245		256	208	
B. Boys Stereotyping of Mathematics	$\bar{x}$	56.12	60.51	- 4.39	58.27	63.47	- 5.20*	60.35	61.32	- .97
	S.E.	2.05	1.73	2.68	1.49	1.79	2.33	1.63	2.25	2.78
	n	197	244		254	244		253	208	
C. Girls Stereotyping of Mathematics	$\bar{x}$	58.10	68.02	- 9.92**	61.88	73.50	-11.62	70.17	77.28	- 7.11**
	S.E.	2.15	2.10	3.01	1.41	1.33	1.94	1.52	1.40	2.07
	n	198	241		255	241		256	208	
D. Counselor Encouragement	$\bar{x}$	58.65	59.77	- 1.12	64.81	65.99	- 1.18	73.74	83.56	- 9.82**
	S.E.	3.32	3.43	4.77	2.51	3.17	4.04	2.54	1.91	3.18
	n	102	139		70	125		59	67	
E. Teacher Encouragement	$\bar{x}$	64.28	66.52	- 2.24	66.31	69.23	- 2.92	73.32	73.47	- .15
	S.E.	1.53	.96	1.81	1.03	1.11	1.51	1.86	1.39	2.32
	n	197	243		256	245		256	208	

(This Table is continued on the next page.)

TABLE H (CONT.)

Variable		Level of Achievement								
		Low			Middle			High		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
F. Teacher Stereotyping of Mathematics	$\bar{x}$	64.96	72.21	- 7.25*	70.38	77.18	- 6.80**	73.67	78.81	- 5.14**
	S.E.	1.75	2.31	2.90	1.27	1.45	1.93	1.22	1.17	1.69
	n	197	241		256	243		256	206	
G. Teacher Differential Treatment	$\bar{x}$	63.88	68.58	- 4.70*	69.07	73.56	- 4.49**	71.76	77.35	- 5.59**
	S.E.	1.28	1.39	1.89	.89	.89	1.26	1.35	.80	1.57
	n	198	244		256	245		256	208	
VIII. School Experience										
A. Grades in Mathematics	$\bar{x}$	2.29	2.20	- .09	2.59	2.82	.23*	3.19	3.22	.03
	S.E.	.11	.09	.14	.04	.09	.10	.07	.09	.12
	n	201	245		257	247		256	208	
IX. Background Variables										
A. Fathers Education	$\bar{x}$	4.45	4.60	.15	3.70	4.35	.65	3.91	3.91	0.00
	S.E.	.22	.26	.35	.25	.26	.36	.19	.18	.26
	n	192	228		237	228		226	188	
B. Mothers Education	$\bar{x}$	4.11	4.13	.02	3.51	3.74	- .23	3.43	3.32	.11
	S.E.	.20	.26	.33	.21	.22	.31	.23	.14	.27
	n	192	228		237	228		226	188	
C. SES	$\bar{x}$	69.24	69.53	- .29	75.41	72.45	2.96	75.64	76.34	- .71
	S.E.	1.55	1.25	1.99	1.07	1.05	1.50	.96	1.16	1.51
	n	192	228		237	228		226	188	

*p<.05
**p<.01

TABLE I

ASPIRATIONS, CURRENT ENVIRONMENT AND BACKGROUND OF GRADE 12 STUDENTS WITHIN ACHIEVEMENT LEVELS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. PERCENTAGES OF RESPONSES BY SEX.

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Career Plans										
A. Career Aspirations										
1. Artists and Entertainers	n	247	204		281	237		366	391	
	%	13.51	12.60	.91	13.19	17.38	- 4.19	6.05	8.09	- 2.04
	S.E.	3.97	2.02	4.45	3.27	3.36	4.69	1.54	1.49	2.14
2. Clerical, Technical and Service Personnel	%	8.05	34.92	-26.87**	16.56	27.69	-11.13	12.07	17.05	- 4.98
	S.E.	1.74	3.93	4.30	4.28	4.69	6.35	1.98	3.20	3.76
3. Executives	%	3.52	.26	3.26	1.30	1.35	- .05	3.69	1.85	1.84
	S.E.	1.25	.20	1.27	.90	.57	1.07	.80	.74	1.09
4. Homemaker	%	2.72	2.19	.53	0.00	1.12	- 1.12	0.00	1.26	- 1.26
	S.E.	1.95	1.22	2.30	0.00	.72	.72	0.00	.41	.41
5. Management and Marketing Personnel	%	4.29	7.71	- 3.42	6.84	6.26	.58	6.63	7.77	- 1.14
	S.E.	1.70	1.99	2.62	2.12	1.69	2.71	1.85	1.65	2.48
6. Professionals	%	17.63	27.91	-10.28	24.28	33.81	- 9.53	58.59	52.66	5.93
	S.E.	4.55	3.53	5.76	4.40	3.66	5.72	3.22	4.09	5.21
7. Semi-Skilled Workers	%	10.65	2.23	8.42**	3.62	3.80	- .18	.38	0.00	.38
	S.E.	2.76	1.09	2.97	1.11	1.53	1.89	.22	0.00	.22
8. Skilled Workers	%	33.02	4.42	28.60**	27.93	3.51	24.42**	7.74	.95	6.79**
	S.E.	5.04	1.17	5.17	4.57	.94	4.67	1.58	.71	1.73

*p<.05
**p<.01
(This Table is continued on the next page.)

TABLE I (CONT.)

Variable		Low Achievement Male	Low Achievement Female	Low Achievement Difference	Middle Achievement Male	Middle Achievement Female	Middle Achievement Difference	High Achievement Male	High Achievement Female	High Achievement Difference
9. I don't know	%	6.30	4.35	1.95	3.82	4.15	- .33	4.75	8.09	- 3.34
	S.E.	3.18	1.55	3.54	1.51	1.46	2.10	1.26	2.03	2.39
II. Parental Influences										
A. Who helped more with Mathematics homework?										
1. Father	n	254	210		290	246		370	399	
	%	15.90	14.48	1.42	25.24	27.58	- 2.34	31.90	30.71	1.19
	S.E.	2.85	2.59	3.85	3.84	3.99	5.54	2.39	3.07	3.89
2. Mother	%	38.23	35.74	2.49	26.62	24.20	2.42	10.96	9.90	1.06
	S.E.	4.03	3.66	5.44	3.84	3.00	4.87	1.73	2.28	2.86
3. Both Equally	%	15.75	10.16	5.59	16.49	16.50	- .01	20.63	12.82	7.81
	S.E.	4.18	2.86	5.06	3.59	2.97	4.66	3.66	2.43	4.39
4. Neither Helped	%	29.11	39.21	-10.10	30.14	31.70	- 1.56	26.15	44.65	- 8.50
	S.E.	4.34	5.67	7.14	3.71	4.11	5.54	3.27	3.09	4.50
B. Who uses more mathematics in your home?										
1. Mother	n	254	210		290	246		370	399	
	%	38.38	45.27	- 6.89	24.19	30.60	- 6.41	15.53	23.00	- 7.47*
	S.E.	3.69	3.47	5.07	3.34	5.21	6.19	1.91	3.04	3.59
2. Father	%	37.68	23.78	13.90**	51.06	40.68	10.38	49.90	38.87	11.03**
	S.E.	3.69	2.83	4.65	4.70	4.21	6.31	2.04	2.55	3.27
3. Both the Same	%	23.94	30.18	- 6.24	24.23	28.70	- 4.47	32.97	26.49	- 3.52
	S.E.	4.14	3.30	5.29	4.39	3.07	5.36	2.06	2.54	3.83

(This Table is continued on the next page.)

TABLE I (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
C. Family Status - which adult do you live with?										
1. Just Father	n	252	207		289	245		369	397	
	%	4.37	.61	3.76*	2.37	2.32	.05	2.69	2.93	- .24
	S.E.	1.59	.30	1.62	1.07	1.20	1.61	.95	1.58	1.84
2. Just Mother	%	21.15	30.67	- 9.52	15.03	19.19	- 4.16	11.39	13.20	- 1.81
	S.E.	4.31	4.07	5.93	3.79	3.82	5.38	2.50	2.26	3.37
3. Both Parents	%	68.47	59.94	8.53	80.98	73.57	7.41	82.52	81.14	1.38
	S.E.	4.94	4.28	6.54	4.04	4.49	6.04	3.15	3.02	4.36
4. Other	%	4.77	7.08	- 2.31	.41	3.68	- 3.27	.65	.47	.18
	S.E.	2.26	1.81	2.90	.28	1.65	1.67	.33	.18	.38
If you live with only one parent, do you see the other often?										
1. Yes	n	252	207		289	245		369	397	
	%	14.84	11.05	3.79	7.51	8.61	- 1.10	9.97	4.78	5.19
	S.E.	3.42	3.05	4.58	1.61	2.50	2.97	3.19	1.57	3.56
2. No	%	17.49	27.27	- 9.78	12.46	16.83	- 4.37	6.00	11.99	- 5.99*
	S.E.	4.55	4.35	6.29	3.21	4.11	5.21	1.53	2.42	2.86
3. I live with both parents	%	66.11	57.49	8.62	77.36	73.27	4.09	80.58	79.24	1.34
	S.E.	4.01	4.49	6.02	3.99	4.43	5.96	2.95	3.17	4.33

(This Table is continued on the next page.)

TABLE I (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	**Female**	**Difference**	**Male**	**Female**	**Difference**	**Male**	**Female**	**Difference**
III. Influences of Significant Others										
A. Siblings - Do you have an older brother good in mathematics?										
1. Yes	n	252	207		289	245		369	397	
	%	41.43	43.27	- 1.84	36.17	45.24	- 9.07	26.25	29.90	- 3.65
	S.E.	5.73	4.63	7.37	4.35	3.74	5.74	2.87	3.37	4.43
2. No	%	54.39	47.07	7.32	59.84	52.71	7.13	67.71	66.43	1.28
	S.E.	6.02	3.88	7.16	4.52	3.84	5.93	2.77	3.46	4.43
Do you have an older Sister good in mathematics?										
1. Yes	n	252	207		289	245		369	397	
	%	50.53	41.06	9.47	40.88	29.53	11.35	25.79	28.71	- 2.92
	S.E.	3.92	4.50	5.97	4.04	4.22	5.84	4.09	2.94	5.04
2. No	%	41.34	52.36	-11.02	53.96	66.43	-12.47*	68.81	66.80	2.01
	S.E.	4.55	4.15	6.16	4.46	4.06	6.03	4.18	3.22	5.28

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TABLE I (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
IV. School Experience										
A. Classify Emphasis of High School Courses										
1. General	n	256	211		290	247		370	399	
	%	47.53	56.47	- 8.94	41.73	37.25	4.48	14.85	16.43	- 1.58
	S.E.	6.27	4.54	7.74	3.90	5.34	6.61	2.81	3.42	4.43
2. Vocational, Technical or Trade	%	37.51	24.42	13.09	21.89	22.49	- .60	9.85	6.30	3.55
	S.E.	6.68	4.04	7.81	3.91	4.17	5.72	2.84	2.01	3.48
3. College Preparatory	%	14.70	18.76	- 4.06	35.05	39.77	- 4.72	75.30	77.28	- 1.98
	S.E.	3.80	3.40	5.10	4.28	5.53	6.99	2.96	3.89	4.89
B. Did you take algebra in 8th Grade?										
1. Yes	n	256	211		290	247		370	399	
	%	19.93	12.70	7.23	20.76	14.65	6.11	33.25	31.96	1.29
	S.E.	5.01	2.73	5.71	3.47	2.83	4.48	5.50	4.12	6.87
2. No	%	79.81	87.29	- 7.48	79.24	85.35	- 6.11	65.44	67.93	- 2.49
	S.E.	5.03	2.73	5.72	3.47	2.83	4.48	5.20	4.11	6.63

(This Table is continued on the next page.)

TABLE I (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
V. Parental Occupation										
A. Which group of careers does your father belong in?										
1. Artists and Entertainers	n	247	204		281	237		366	391	
	%	3.64	.15	3.49	.16	.75	- .59	.33	1.71	- 1.38
	S.E.	3.11	.02	3.11	.16	.56	.58	.26	.77	.81
2. Clerical, Tehcnical and Service Personnel	%	3.53	12.58	- 9.05*	10.68	11.01	- .33	12.61	12.81	- .20
	S.E.	1.28	4.11	4.30	2.58	2.88	3.87	3.82	2.42	4.52
3. Executives	%	3.88	4.31	- .43	6.33	9.39	- 3.06	11.65	5.57	6.08
	S.E.	1.65	1.28	2.09	2.22	2.86	3.62	1.50	1.15	1.89
4. Homemakers	%	3.19	1.58	1.61	1.47	1.32	.15	.15	.31	- .16
	S.E.	1.56	1.29	2.02	1.41	1.27	1.90	.15	.30	.34
5. Management and Marketing Personnel	%	9.80	10.23	- .43	16.48	11.98	4.50	20.03	16.54	3.49
	S.E.	2.58	2.05	3.30	2.51	2.67	3.66	3.17	1.83	3.66
6. Professionals	%	13.77	3.57	10.20*	7.50	12.56	- 5.06	27.51	20.98	6.53
	S.E.	4.42	1.44	4.65	2.28	3.00	3.77	3.64	2.47	4.40
7. Semi-Skilled Workers	%	26.84	29.41	- 2.57	21.89	19.77	2.12	10.52	19.25	- 8.73*
	S.E.	5.14	3.87	6.43	4.23	3.41	5.43	2.05	3.22	3.82
8. Skilled Workers	%	26.93	28.00	- 1.07	30.21	29.60	.61	15.23	14.94	.29
	S.E.	4.85	4.79	6.82	4.82	4.99	6.94	2.56	2.01	3.25

(This Table is continued on the next page.)

TABLE I (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
B. Which group of careers does your mother belong in?										
1. Artists and Entertainers	n	247	204		281	237		366	391	
	%	2.18	.23	1.95	1.51	1.71	- .20	.17	.77	- .60
	S.E.	1.17	.19	1.19	.32	1.23	1.27	.13	.44	.46
2. Clerical, Technical and Service Personnel	%	19.07	22.13	- 3.06	18.71	24.11	- 5.40	29.25	24.34	3.54
	S.E.	3.74	3.76	5.30	4.16	3.61	5.51	4.14	24.11	3.61
3. Executives	%	4.25	3.57	.68	.60	.47	.13	2.58	1.64	.94
	S.E.	3.12	2.43	3.95	.11	.36	.38	1.37	1.35	1.92
4. Homemakers	%	21.60	27.74	- 6.14	33.36	31.42	1.94	27.40	39.87	-12.47*
	S.E.	3.61	4.86	6.05	4.08	3.83	5.60	2.85	3.87	4.81
5. Management and Marketing Personnel	%	6.74	7.17	- .43	4.80	2.87	1.93	9.01	2.47	6.54*
	S.E.	2.04	2.33	3.10	1.66	1.05	1.96	1.74	.78	1.91
6. Professionals	%	6.44	11.26	- 4.82	11.02	15.37	-4.35	17.43	16.54	.89
	S.E.	2.11	2.35	3.16	3.25	2.92	4.37	2.28	2.86	3.66
7. Semi-Skilled Workers	%	18.77	19.76	- .99	17.66	19.13	- 1.47	10.25	7.41	2.84
	S.E.	4.16	3.30	5.31	3.59	4.31	5.61	2.02	1.69	2.63
8. Skilled Workers	%	3.63	1.08	2.55	.05	1.96	- 1.91	.80	2.71	- 1.91
	S.E.	2.13	.66	2.23	.05	1.30	1.30	.41	1.12	1.19

*p<.05
**p<.01

TABLE J

ASPIRATIONS, CURRENT ENVIRONMENT AND BACKGROUND OF 13 YEAR OLD STUDENTS WITH ACHIEVEMENT LEVELS FROM THE WOMEN AND MATHEMATICS NATIONAL SURVEY, FALL, 1978. PERCENTAGES OF RESPONSES BY SEX.

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
I. Career Plans										
A. Career Aspirations										
1. Artists and Entertainers	n	192	228		237	228		226	188	
	%	14.83	11.97	2.86	12.02	15.86	- 3.84	13.59	17.85*	- 4.26
	S.E.	2.45	2.23	3.31	2.74	2.65	3.81	2.43	3.08	3.92
2. Clerical, Technical and Service Personnel	%	8.41	13.73	- 5.32	14.19	16.71	- 2.52	11.07	14.06	- 2.99
	S.E.	1.99	2.37	3.09	2.79	2.62	3.83	2.53	1.95	3.19
3. Executives	%	5.39	4.44	.95	5.57	2.40	3.17	3.37	1.88	1.49
	S.E.	1.97	1.70	2.60	1.97	1.40	2.42	1.67	1.01	1.95
4. Homemakers	%	4.64	8.42	- 3.78	1.66	1.95	- .29	0.00	3.79	- 3.79
	S.E.	1.46	2.56	2.95	.97	.99	1.39	0.00	1.35	1.35
5. Management and Marketing Personnel	%	7.98	4.93	3.05	8.92	3.21	5.71*	5.11	3.32	1.79
	S.E.	1.95	1.93	2.74	1.84	1.47	2.36	1.69	1.41	2.20
6. Professionals	%	11.68	31.45	-19.77**	20.54	45.18	-24.64**	32.89	42.96	-10.07
	S.E.	2.59	2.60	3.67	3.00	4.72	5.59	3.49	3.22	4.75
7. Semi-Skilled Workers	%	11.97	6.07	5.90	11.96	3.18	8.78**	7.41	.90	6.51
	S.E.	2.36	2.03	3.11	2.28	1.27	2.61	2.42	.71	2.52
8. Skilled Workers	%	19.97	5.05	14.92**	15.46	3.58	11.88**	16.21	2.65	13.56
	S.E.	2.79	1.55	3.19	2.40	.82	2.54	2.93	1.13	3.14

(This Table is continued on the next page.)

TABLE J (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
II. Parental Influences										
A. Who helped more with mathematics homework?										
1. Father	n	200	244		257	247		256	208	
	%	23.09	19.36	3.73	22.84	21.03	1.81	28.70	35.52	- 6.82
	S.E.	3.78	3.07	4.87	3.32	3.39	4.74	3.07	4.31	5.29
2. Mother	%	38.36	38.65	- .29	36.34	40.46	- 4.12	31.41	28.58	2.83
	S.E.	4.15	3.46	5.40	3.23	3.45	4.73	2.98	2.99	4.22
3. Both Equally	%	22.15	24.34	- 2.19	23.71	24.34	- 2.19	23.71	20.63	3.08
	S.E.	3.63	3.90	5.33	3.36	3.90	5.33	3.36	2.43	4.15
4. Neither Helped	%	13.86	16.87	- 3.01	14.52	17.44	- 2.92	13.25	14.72	- 1.47
	S.E.	2.33	2.83	3.67	2.57	3.88	4.65	2.06	2.39	3.16
B. Who uses more mathematics in your home?										
	n	200	244		257	247		256	208	
1. Mother	%	28.43	30.99	- 2.56	33.06	30.94	2.12	25.69	20.32	5.37
	S.E.	3.13	3.13	4.43	3.04	4.26	5.23	3.01	2.49	3.91
2. Father	%	40.47	30.11	10.36	39.19	32.91	6.28	48.03	40.87	7.16
	S.E.	3.53	3.08	4.68	3.46	3.79	5.13	3.42	2.70	4.36
3. Both the same	%	28.23	38.03	- 9.80	25.84	35.54	- 9.70	26.28	38.19	-11.91
	S.E.	3.36	4.17	5.36	2.95	3.09	4.27	2.61	2.55	3.65

(This Table is continued on the next page.)

TABLE J (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
C. Family Status - Which adult do you live with?										
1. Just Father	n	198	244		256	246		256	208	
	%	2.87	3.54	- .67	.89	1.85	- .96	2.22	1.15	1.07
	S.E.	1.11	1.33	1.73	.47	.95	1.06	1.14	.68	1.33
2. Just Mother	%	15.57	27.98	-12.41	18.89	17.04	1.85	9.19	12.40	- 3.21
	S.E.	3.70	4.03	5.47	3.00	3.19	4.38	2.18	2.34	3.20
3. Both Parents	%	73.10	62.01	11.09	74.76	78.31	- 3.55	87.40	84.56	2.84
	S.E.	3.64	3.84	5.29	3.36	3.56	4.90	2.68	2.46	3.64
4. Other	%	7.19	4.33	2.86	3.72	2.22	1.50	1.00	1.88	- .88
	S.E.	1.97	1.68	2.59	1.53	1.03	1.84	.99	.95	1.37
If you live with only one parent, do you see the other one often?										
1. Yes	n	198	244		256	246		256	208	
	%	15.47	18.67	- 3.20	11.01	9.17	1.84	7.49	4.64	2.85
	S.E.	2.65	3.97	4.77	2.40	1.71	2.95	2.26	1.28	2.60
2. No	%	18.85	22.47	- 3.62	15.37	12.93	2.44	8.08	9.87	- 1.79
	S.E.	3.31	2.97	4.45	2.96	2.55	3.91	1.94	2.30	3.01
3. I live with both parents.	%	61.87	56.72	5.15	71.59	77.16	- 5.57	83.81	84.78	- .97
	S.E.	3.73	4.20	5.62	3.05	3.39	4.56	3.37	2.61	4.26

(This Table is continued on the next page.)

TABLE J (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
III. Influences of Significant Others										
A. Siblings - Do you have an older borther good in mathematics?										
1. Yes	n	198	244		256	246		256	208	
	%	45.33	50.37	- 5.04	33.42	43.86	-10.44	36.17	27.06	9.11
	S.E.	3.78	4.39	5.79	3.52	3.89	5.25	4.29	3.56	5.57
2. No	%	46.00	44.58	1.42	56.97	51.39	5.58	57.15	69.25	-12.10
	S.E.	4.46	3.94	5.95	3.57	3.58	5.06	3.88	4.20	5.72
Do you have an older sister good in mathematics?										
1. Yes	n	198	244		256	246		256	208	
	%	42.43	40.08	2.35	48.88	45.78	3.10	58.19	61.66	- 3.47
	S.E.	4.08	3.57	5.42	3.77	3.39	5.07	4.38	3.32	5.50
2. No	%	49.44	50.27	- .83	46.32	49.48	- 3.16	36.14	26.68	- .54
	S.E.	3.69	4.68	5.96	3.76	3.35	5.04	4.35	3.32	5.47
IV. School Experience										
A. Classify Emphasis of High School Courses										
1. General	n									
	%									
	S.E.									

(This Table is continued on the next page.)

TABLE J (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
2. Vocational, Technical or or Trade	% S.E.									
3. College Preparatory	% S.E.									
B. Did you take algebra in 8th Grade?										
1. Yes	n	201	245		257	247		256	208	
	%	9.25	11.25	- 2.00	6.93	11.96	- 5.03	29.30	42.14	-12.84
	S.E.	1.74	3.04	3.50	1.64	1.85	2.47	4.17	5.36	6.79
2. No	%	56.58	58.96	- 2.38	73.69	67.66	6.03	59.55	50.66	8.89
	S.E.	4.17	4.13	5.87	2.85	3.64	4.62	4.06	5.12	6.53
3. Not yet in 8th grade	%	32.21	28.46	3.75	18.12	20.38	- 2.26	11.16	6.83	4.33
	S.E.	3.73	4.57	5.90	3.01	3.39	4.53	2.15	1.73	2.76
V. Parental Occupation										
A. In which group of careers does your father begong?										
1. Artists and Entertainers	n	192	228		237	228		226	188	
	%	2.04	.25	1.79	2.01	1.03	.98	.85	1.12	- .27
	S.E.	.93	.19	.95	.99	.66	1.19	.83	.78	1.14
2. Clerical, Technical and Service Personnel	%	11.75	9.47	2.28	12.61	10.89	1.72	11.99	16.78	- 4.79
	S.E.	2.58	2.53	3.61	2.39	2.47	3.44	2.97	3.08	4.28
3. Executives	%	8.05	9.40	- 1.35	6.67	6.72	- .05	7.65	8.39	- .74
	S.E.	1.72	2.57	3.09	2.10	1.53	2.60	2.21	1.66	2.76

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TABLE J (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
4. Homemakers	%	2.43	3.76	- 1.33	1.92	2.10	- .18	0.00	1.06	- 1.06
	S.E.	1.08	1.96	2.24	1.11	1.16	1.61	0.00	.77	.77
5. Management and Marketing Personnel	%	10.98	10.07	.91	13.62	13.39	.23	13.71	14.69	- .98
	S.E.	2.15	2.18	3.06	2.04	2.79	3.46	2.70	2.43	3.63
6. Professionals	%	7.11	8.97	- 1.86	8.25	9.04	- .79	11.55	9.65	1.90
	S.E.	1.51	2.10	2.59	2.08	1.99	2.88	2.07	1.88	2.80
7. Semi-Skilled Workers	%	21.53	20.59	.94	24.34	21.43	2.91	24.54	17.78	6.76
	S.E.	3.58	2.68	4.47	2.90	2.81	4.04	4.35	3.31	5.47
8. Skilled Workers	%	25.45	21.84	3.61	20.42	26.35	- 5.93	21.03	19.82	1.21
	S.E.	3.16	3.21	4.50	2.04	3.12	3.73	2.51	3.51	4.32
B. In which group of careers does your mother belong?										
1. Artists and Entertainers	n	192	228		237	228		226	188	
	%	4.89	3.99	.90	1.15	.89	.26	3.58	.58	3.00
	S.E.	2.03	1.58	2.57	.71	.58	.92	1.45	.55	1.55
2. Clerical, Technical and Service Personnel	%	16.95	13.95	3.00	16.85	22.03	- 5.18	21.71	20.54	1.17
	S.E.	2.39	2.94	3.79	2.39	3.24	4.03	2.98	2.88	4.14
3. Executives	%	3.79	4.89	- 1.10	5.19	2.03	3.16	3.98	1.67	2.31
	S.E.	1.34	1.53	2.03	1.60	1.04	1.91	1.80	.87	2.00
4. Homemaker	%	21.83	25.04	- 3.21	23.13	30.77	- 7.64	33.47	33.11	.36
	S.E.	2.27	3.58	4.24	2.99	3.22	4.39	4.37	3.22	5.43
5. Management and Marketing Personnel	%	7.54	7.73	- .19	8.07	7.99	.08	2.28	5.51	- 3.23
	S.E.	2.16	2.70	3.46	2.11	2.02	2.92	1.21	1.60	2.01

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TABLE J (CONT.)

Variable		Low Achievement			Middle Achievement			High Achievement		
		Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
6. Professionals	%	9.67	12.80	- 3.13	11.41	7.96	3.45	10.58	14.09	- 3.51
	S.E.	2.22	2.89	3.64	2.12	1.72	2.73	2.69	2.42	3.62
7. Semi-Skilled Workers	%	8.55	17.55	- 9.00	15.78	17.19	- 1.41	9.57	11.44	- 1.87
	S.E.	1.61	2.96	3.37	3.12	2.67	4.11	2.44	2.43	3.44
8. Skilled Workers	%	4.80	1.71	3.09	3.13	2.75	.38	3.08	1.74	1.34
	S.E.	1.71	.97	1.97	1.26	1.38	1.87	1.34	.83	1.58

*p<.05
**p<.01

APPENDIX F

TECHNICAL PROCEDURES: SAMPLING AND ESTIMATION OF STANDARD ERRORS

This appendix describes technical procedures used in the sample design and sample selection. It also provides details about procedures used for estimating standard errors of the statitstics used in this report.

The sample design, sample selection and data collection for both populations surveyed were done by the staff of the Research Triangle Intitute, Raleigh, North Carolina.

Sampling

The target populations for this survey consisted of 13-year-old and students in the twelfth grade enrolled in either public or private schools who were not functionally handicapped to the extent they could not participate in a survey. Specific groups excluded were: non-English speaking persons, those identified as non-readers during the survey, persons physically or mentally unable to respond, and persons in institutions or attending schools established for the physically handicapped or mentally retarded.

Survey booklets took 90 minutes to complete and were administered to groups of between 12 and 35 students. Specially trained field personnel administered the booklets. These procedures ensured a relatively high degree of consistency of administration and quality control of field procedures with minimum impact or burden on the cooperating schools.

The NAEP uses a deeply stratified, three stage national probability sample design with oversampling of low-income areas. For this study, a half sample was used with oversampling of high school seniors who had taken advanced mathematics (trigonometry or higher).

In the first stage of sampling, the United States is divided into geographical units of counties or groups of contiguous counties meeting a minimum size requirement. These units, called primary sampling units (PSUs), are stratified by region and size of community. From the list of PSUs, a sample of PSUs is drawn without replacement with probability proportional to population size measure, representing all regions and sizes of communities. Oversampling of low-income and extreme-rural areas is performed at this stage by adjusting the estimated population size measure of these areas to increase sampling rates.

In the second stage, all public and private schools within each PSU selected in the first stage are listed. Schools within each PSU are selected without replacement with probabilities proportional to the number of age eligibles in the school.

The third stage of sampling occurs during the data collection period. A list of all age-eligible students within each selected school is made. A simple random selection of eligible students, without replacement, is obtained, and survey booklets are administered to selected students by trained personnel.

Each respondent in the sample does not have the same probability of selection because some subpopulations are oversampled, and adjustments are made to compensate for some schools' refusal to participate and for student nonresponse. The selection probability of each individual is computed, and its reciprocal is used to weight each response in any statistical calculation to compensate for unequal rates of sampling and to ensure proper representation in the population structure.

The number of PSUs, schools within PSUs and students within schools are determined by optimum sampling principles. That is, a sample design is selected that will maximize precision while remaining within the budgetary constraints.

Selection of Oversampled Population

A separate oversample was drawn of males and females who were presently enrolled in trigonometry or a higher level mathematics course. This was to ensure there would be enough advanced matematics students in the sample for statistical analysis. Each of the schools in the grade 12 sample completed three different student listing forms (SLF). SLF 1 listed every eligible 12th grade female student who was enrolled in an advanced course. SLF 2 listed every eligible male student who was enrolled in an advanced course. SLF 3 was a list of every eligible 12th grade student, including the students on SLF's 1 and 2. If the school offered no advanced mathematics courses, only SLF 3 was completed.

First, the list of eligible students in each school on each SLF was completed. The previously determined sampling plan designated the numbers of students to be drawn from each SLF at each school. RTI administrators selected students according to the predetermined numbers starting with SLFs 1 and 2. Remainders were selected from SLF 3. Selection of students to be surveyed from the list of eligibles was done using random numbers.

Estimation of Standard Errors

Measures of Achievement

Based on the sample design, a weight is assigned to every individual who responds to an exercise administered in an assessment. The weight is the reciprocal of the probability of selecting a particular individual to take a particular exercise. Since the probabilities of selection are based on an estimated number of people in the target age population, the weight for an individual estimates the number of similar people that that individual represents in the age population.

A sum of the weights for all individuals at an age level responding to an exercise is an estimate of the total number of people in that age population. A sum of weights for all individuals at an age responding correctly to an exercise is an estimate of the number of people who would be able to respond correctly in the age population, if the entire population were assessed. These concepts also apply to any reporting group (e.g., defined by region, sex, race, etc.) and category of response (e.g., correct, incorrect and "I don't know).

Let W^{e}_{ihk} = sum of weights for respondents to exercise e who are in reporting subgroup i who are in the kth PSU of the hth sampling stratum.

C^{ej}_{ihk} = sum of weights for respondents to exercise e who are in subgroup i, who are in the kth PSU of stratum h and who selected response category j (e.g., correct response) for the exercise.

Note that $W^{e}_{ihk} = \sum_{j} C^{ej}_{ihk}$.

Then, summing k over the n_h, sample PSUs in stratum h, and summing over the H sampling strata, $W^{e}_{i++} = \sum_{h=1}^{H} \sum_{k=1}^{n_h} W^{e}_{ihk}$ estimates the number of eligibles in the population who are in subgroup i.

The proportion of eligibles in the population who are in subgroup i and who would select response category j for exercise e is then estimated by

$$C^{ej}_{i++} = \sum_{h=1}^{H} \sum_{k=1}^{n_h} C^{ej}_{ihk}$$

(1) $P_i^{ej} = C_{i++}^{ej} / W_{i++}^{e}$.

In the special case where the proportion of all age eligibles who would select response category j on exercise e is estimated, the index A (for All) will be used in place of i as follows:

(2) $P_A^{ej} = C_{A++}^{ej} / W_{A++}^{e}$.

In National Assessment reports, the proportion in (1) multiplied by 100 is called the group percentage, and the proportion in (2) multiplied by 100 is called the national percentage. The difference between the proportion in subgroup i who would select category j on exercise e and the proportion in the nation is denoted by:

(3) $\Delta P_i^{ej} = P_i^{ej} - P_A^{ej}$.

National Assessment also reports the arithmetic mean of the percentage of correct responses over sets of exercises corresponding to the measures in (1), (2) and (3). These means are taken over the set of all exercises or a subset of exercises classified by a reporting topic or content objective. The mean percentage of correct responses taken over m exercises in some set of exercises corresponding to measures (1), (2) and (3) are, respectively:

(4) $\overline{P}_i = \frac{1}{m} \sum_e C_{i++}^{e} / W_{i++}^{e}$,

(5) $\overline{P}_A = \frac{1}{m} \sum_e C_{A++}^{e} / W_{i++}^{e}$ and

(6) $\overline{\Delta P}_i = \overline{P}_i - \overline{P}_A$.

Note that the response category subscript j has been suppressed since the means are understood to be taken over the correct response category for each exercise.

Computation of Standard Errors

In order to obtain an approximate measure of the sampling variability in the statistics (1) through (6), a jackknife replication procedure for estimating the sampling variance of nonlinear statistics from complex, multistage samples was tailored to National Assessment's sample design.

To demonstrate the computational aspects of this technique, consider estimating the variance of the statistic in (1) -- the proportion of age eligibles in subgroup i who would select response category j on exercise e.

This statistic is based on data from all the n_h PSUs in the H strata. Let P^{ej}_{i-hk} be defined as a replication estimate of P^{ej}_{i} and constructed from all the PSUs, excluding the data from PSU k in stratum h. These replication estimates are computed as if the excluded PSU had not responded and a reasonable nonresponse adjustment is used to replace the data in PSU hk in estimating P^{ej}_{i}. Several choices for replacing the data in PSU hk are available. In order to obtain a convenient and computationally efficient algorithm for approximating standard errors, National Assessment replaces C^{ej}_{ihk} and W^{e}_{ihk} from the hkth PSU with corresponding sums from another paired PSU in the same stratum. The replicate estimate is then computed. The replicate estimates to be used in the calculations are determined by arranging all of the PSUs in each stratum into successive pairs. That is, PSU 1 is paired with PSU 2, PSU 2 with PSU 3, 3 with 4, ... (N_h-1) with n_h and PSU n_h with PSU 1.

The contribution to the variance of P^{ej}_{i} by each pair of PSUs is the change in the value of the statistic incurred by replacing the data from each PSU in the pair with the data from the other PSU in the pair and recomputing P^{ej}_{i} in the usual way. This produces two replicate estimates. Squaring the difference between these replicate estimates and then dividing by eight measures the contribution of this pair of PSUs to the total variance. The sum of these contributions over all n_h successive pairs in the stratum is the contribution by stratum h to the total variance. The square root of the sum of the H stratum contributions is the estimate of the standard error of P^{ej}_{i}.

Algebraically, the two replicate estimates for the pair k, k+1 (where $k=1, \ldots, n_h$ and $n_h+1 = 1$) are:

$$(7) \quad P^{ej}_{i-hk(k+1)} = \frac{C^{ej}_{i++} - C^{ej}_{ihk} + C^{ej}_{ih(k+1)}}{W^{e}_{i++} - W^{e}_{ihk} + W^{e}_{ih(k+1)}}$$

and

$$(8) \quad P^{ej}_{i-h(k+1),k} = \frac{C^{ej}_{i++} - C^{ej}_{ih(k+1)} + C^{ej}_{ihk}}{W^{e}_{i++} - W^{e}_{ih(k+1)} + W^{e}_{ihk}} .$$

The contribution to the total variance from stratum h is:

$$(9) \quad \text{var}\ (P^{ej}_{ih}) = \frac{1}{8} \sum_{k}^{n_h} (P^{ej}_{i-hk(k+1)} - P^{ej}_{i-h(k+1),k})^2 .$$

And, finally, an estimate of the standard error of P^{ej}_i is:

$$(10) \quad \text{SE}\ (P^{ej}_i) = (\sum_{h}^{H} \text{var}\ P^{ej}_{hk})^{\frac{1}{2}} .$$

Multiplying P^{ej}_i by 100 yields the percentage of response to category j. Multiplying SE (P^{ej}_i) by 100 yields the corresponding estimated standard error of the percentage.

In general, the jackknifed standard errors of the proportion estimates will be larger than the simple random sampling formula $(pq/n)^{\frac{1}{2}}$, where $p = P^{ej}_i$, $q = 1-p$ and n is the number of sampled respondents in subgroup i who took the exercise. The larger size of SE (P^{ej}_i) reflects mainly the loss of precision due to cluster-sampling of schools and students.

The standard errors for the achievement measures (2) through (6) are computed through a series of steps analogous to those followed in computing SE (P^{ej}_i).

The most complicated step in computing standard errors occurs in forming the paired replicate estimates analogous to (7) and (8) for each successive pair of PSUs. Once this bookkeeping chore is done, the computations for (9) and (10) follow in a straightforward manner.

The standard errors for the sex differences for any of the measures are computed as the square root of the sum of the squared standard errors from each of the male and female means or frequency of responses.

The size of the standard error depends largely on the number of PSUs and schools in the sample, the number of respondents in each reporting group and the number of exercises in each exercise set.

APPENDIX G

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APPENDIX H

Intercorrelations of Revised Scales

TABLE K
INTERCORRELATIONS OF REVISED SCALES
FOR GRADE 12 MALES

	MATHATT	ATTWOMEN	PARENC	SCHANX	TEACHATT	USEFUL	TEACHENC	TEACHDIF	FATHROLE	MOTHROLE
MATHATT										
ATTWOMEN	.170*									
PARENC	.397*	.145*								
SCHANX	.228*	.270*	.200*							
TEACHATT	.239*	.378*	.323*	.246*						
USEFUL	.516	.192	.451	.077	.160*					
TEACHENC	.376	.262	.453	.203*	.547*	.370*				
TEACHDIF	.209	.243	.313	.252*	.711*	.183*	.549*			
FATHROLE	.149	.109	.467*	.032	.193*	.228*	.218*	.228*		
MOTHROLE	.048	.109	.313*	.117	.131	.152	.144	.094	.279*	

*p <.001

MATHATT = Attitude Toward Math
ATTWOMEN = Stereotyping of Women
PARENC = Parental Encouragement
SCHANX = School Anxiety
TEACHATT = Teacher Stereotyping

USEFUL = Usefulness
TEACHENC = Teacher Encouragement
TEACHDIF = Teacher Differential Treatment
FATHROLE = Father as a Role Model
MOTHROLE = Mother as a Role Model

TABLE M
INTERCORRELATIONS OF REVISED SCALES FOR 13-YEAR-OLD MALES

	MATHATT	ATTWOMEN	PARENC	SCHANX	TEACHATT	USEFUL	TEACHENC	TEACHDIF	FATHROLE	MOTHROLE
MATHATT										
ATTWOMEN	.243*									
PARENC	.329*	.219*								
SCHANX	.257*	.201*	.143							
TEACHATT	.179*	.469*	.395*	.142						
USEFUL	.368*	.325*	.407*	.224*	.299*					
TEACHENC	.332*	.317*	.497*	.123	.529*	.291*				
TEACHDIF	.252*	.349*	.394*	.150	.578*	.347*	.543*			
FATHROLE	.234*	.198*	.598*	.149	.380*	.297*	.354*	.388*		
MOTHROLE	.253*	.189*	.513*	.123	.325*	.255*	.353*	.298*	.356*	

*p< .001

MATHATT = Attitude Toward Math
ATTWOMEN = Stereotyping of Women
PARENC = Parental Encouragement
SCHANX = School Anxiety
TEACHATT = Teacher Stereotyping

USEFUL = Usefulness
TEACHENC = Teacher Encouragement
TEACHDIF = Teacher Differential Treatment
FATHROLE = Father as a Role Model
MOTHROLE = Mother as a Role Model

TABLE L
INTERCORRELATIONS OF REVISED SCALES
FOR GRADE 12 FEMALES

	MATHATT	ATTWOMEN	PARENC	SCHANX	TEACHATT	USEFUL	TEACHENC	TEACHDIF	FATHROLE	MOTHROLE
MATHATT										
ATTWOMEN	.142									
PARENC	.377*	.135								
SCHANX	.075	.241*	.083							
TEACHATT	.109	.283*	.177*	.014						
USEFUL	.480*	.214*	.445*	.002	.205*					
TEACHENC	.395*	.142	.391*	.055	.425*	.405*				
TEACHDIF	.133	.275*	.171*	.036	.574*	.194*	.453*			
FATHROLE	.084	.146	.329*	.135	.081	.170*	.101	.142		
MOTHROLE	.161*	.019	.325*	.001	.002	.139	.059	.002	.066	

*p < .001

MATHATT = Attitude Toward Math
ATTWOMEN = Stereotyping of Women
PARENC = Parental Encouragement
SCHANX = School Anxiety
TEACHATT = Teacher Stereotyping

USEFUL = Usefulness
TEACHENC = Teacher Encouragement
TEACHDIF = Teacher Differential Treatment
FATHROLE = Father as a Role Model
MOTHROLE = Mother as a Role Model

TABLE N
INTERCORRELATIONS OF REVISED SCALES FOR 13-YEAR-OLD FEMALES

	MATHATT	ATTWOMEN	PARENC	SCHANX	TEACHATT	USEFUL	TEACHENC	TEACHDIF	FATHROLE	MOTHROLE
MATHATT										
ATTWOMEN	.207*									
PARENC	.304*	.104								
SCHANX	x262*	.289*	.184*							
TEACHATT	.191*	.296*	.326*	.211*						
USEFUL	.299*	.322*	.361*	.192*	.262*					
TEACHENC	.341*	.118	.514*	.141	.477*	.293*				
TEACHDIF	.255*	.276*	.339*	.249*	.540*	.265*	.474*			
FATHROLE	.189*	.110	.492*	.155	.283*	.186*	.283	.328*		
MOTHROLE	.170*	.003	.411*	.053	.185*	.220*	.279*	.143*	.177*	

*p < .001

MATHATT = Attitude Toward Math
ATTWOMEN = Stereotryping of Women
PARENC = Parental Encouragement
SCHANX = School Anxiety
TEACHATT = Teacher Stereotyping

USEFUL = Usefulness
TEACHENC = Teacher Encouragement
TEACHDIF = Teacher Differential Treatment
FATHROLE = Father as a Role Model
MOTHROLE = Mother as a Role Model